Irrigated Pear Orchard Near Camino, El Dorado County, Elevation Over 3,000 Feet

Courtesy of El Dorado County Chamber of Commerce

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

GOODWIN J. KNIGHT, Governor
FRANK B. DURKEE, Director of Public Works
HARVEY O. BANKS, Acting State Engineer

Bulletin No. 56

SURVEY OF MOUNTAINOUS AREAS

December, 1955

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Goodwin J. Knight
Governor

STATE OF CALIFORNIA

Department of Public Works

SACRAMENTO

December 20, 1955

HONORABLE GOODWIN J. KNIGHT, *Governor, and*
Members of the Legislature of the
State of California

GENTLEMEN: I have the honor to transmit herewith Bulletin No. 56 of the Division of Water Resources, Department of Public Works, entitled "Survey of Mountainous Areas," as authorized by the Flood Control Fund Act of 1946, Chapter 142, Statutes of 1946, and by Chapter 30, Statutes of 1947.

The Survey of Mountainous Areas was conducted and Bulletin No. 56 was prepared by the Division of Water Resources, under the direction of the State Engineer.

Bulletin No. 56 contains an inventory of the water resources of the mountainous areas, results of land use and irrigable land surveys, estimates of present and future water utilization and future water requirements, and possible plans for water development.

Very truly yours,

Frank B. Durkee

Frank B. Durkee
Director of Public Works

HARVEY O. BANKS, ACTING STATE ENGINEER
CHIEF OF DIVISION

GOODWIN J. KNIGHT
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December 20, 1955

MR. FRANK B. DURKEE
Director of Public Works
Public Works Building
Sacramento, California

DEAR MR. DURKEE: There is transmitted herewith Bulletin No. 56 of the Division of Water Resources, Department of Public Works, entitled "Survey of Mountainous Areas," as authorized by the Flood Control Fund Act of 1946, Chapter 142, Statutes of 1946, and by Chapter 30, Statutes of 1947.

Under provisions of the cited statutes, funds in the amount of $250,000 were appropriated to the Department of Public Works

> ". . . for surveying projects for the control, conservation and utilization of water resources for any beneficial purpose required for mountainous areas of this state . . ."

The Survey of Mountainous Areas was conducted and Bulletin No. 56 was prepared by the Division of Water Resources, Department of Public Works, under the direction of the State Engineer. Additional funds provided by the Legislature have been expended by the Division of Water Resources in connection with the current State-wide Water Resources Investigation, certain results of which were used in connection with the Survey of Mountainous Areas.

The area investigated, designated as the "Mother Lode Region," embraces the mountain and foothill areas of the west slope of the central Sierra Nevada, including all of Amador, Calaveras, Mariposa, and Tuolumne Counties; major portions of Butte, El Dorado, Nevada, Placer, and Yuba Counties; and smaller portions of Merced, Sacramento, San Joaquin, and Stanislaus Counties.

Bulletin No. 56 contains an inventory of the surface water resources of the region, results of surveys conducted to determine the location and extent of irrigable lands and their present utilization, estimates of present and future water utilization, ultimate water requirements, demands for water, and possible plans for water development in the Mother Lode Region.

Very truly yours,

Harvey O. Banks

Harvey O. Banks
Acting State Engineer

ACKNOWLEDGMENT

Valuable assistance and data used in the investigation were contributed by agencies of the Federal Government, by cities, counties, and public districts, by private companies and individuals, and by the University of California. This cooperation is gratefully acknowledged.

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STATE DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

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CHAPTER I
INTRODUCTION

Almost one-fourth of the surface water resources of California originates within the central Sierra Nevada region—the area under investigation in this bulletin. Although the water resources of the area far exceed its own ultimate water requirements, these resources have not been generally developed for use within the region itself except in some small local areas. The large water supply projects which exist on most of the major streams have been developed for the irrigation of agricultural areas on the Central Valley floor, for municipal and industrial use in the metropolitan areas of the San Francisco Bay region, and for the generation of a substantial portion of the hydroelectric energy produced in California. The rapid increase in population in the State since World War II has resulted in increasing demands for the construction of new conservation projects on Sierra Nevada streams, primarily to satisfy increasing needs for water outside the mountainous areas where the water originates. Some of these projects have already reached construction stages.

Partly as a result of these increasing drafts on the water supply by outside agencies, and partly as a result of the accelerated growth which the mountain and foothill areas themselves have experienced since World War II, the people of the region have shown mounting concern regarding the disposition of the local water resources. Their own demands for water are rising, and they consider the possibility that continued appropriation of water for use in outside areas may jeopardize their own future development. Their concern is evidenced by the formation in recent years of a number of new public water supply agencies, by the filing of numerous applications to appropriate water for present and future needs, and by general opposition to new applications to appropriate water filed by agencies serving areas outside the region.

It is a generally recognized principle that appropriations and development of water should not so operate as to reduce available water supplies below that required to satisfy present and future needs in the areas where the water originates. It is equally recognized that the continued growth of agriculture, industry, and population in California can be sustained only if surplus waters from areas of origin are made available for export to areas of deficiency. It is essential, therefore, that the maximum future needs for water within the mountain and foothill areas of origin be carefully determined, so that maximum development of the water resources of those areas may be planned on an equitable basis for the benefit of all concerned.

AUTHORIZATION FOR INVESTIGATION

In pursuance of the policy declared and adopted in the Water Resources Act of 1945, Chapter 1514, Statutes of 1945, the Legislature of the State of California created the Flood Control Fund by Chapter 142, Statutes of 1946. Section 15 of the statute reads as follows:

"Sec. 15. Of the money in the Flood Control Fund of 1946, not more than two hundred fifty thousand dollars ($250,000) is hereby allocated to the Department of Public Works for expenditure only for the purpose of surveying flood control projects required for the mountainous areas of this State, including present sources of water supply and the present means of controlling the same for such areas, and reporting to the Legislature thereon."

By letter dated June 12, 1946, the Director of Public Works authorized and directed the Division of Water Resources, acting through the State Engineer, to act for the Department of Public Works to conduct the survey as outlined in Section 15 of the Flood Control Fund Act of 1946. The language of Section 15 was such that projects other than those of a purely flood control nature were excluded from the survey, and effective investigation of water resources problems of the mountainous areas could not be undertaken.

The 1947 Session of the State Legislature enacted Chapter 30, Statutes of 1947, which states as follows:

"Sec. 1. The unexpended and unencumbered balance of funds appropriated to the Flood Control Fund of 1946 by the Flood Control Fund Act of 1946 and allocated to the Department of Public Works by Section 15 of said act, is hereby reappropriated to the Department of Public Works to be expended exclusively for surveying projects for the control, conservation and utilization of water resources for any beneficial purpose required for mountainous areas of this State and reporting to the Legislature thereon.

"Sec. 2. The appropriation made by this act shall be available for expenditure without regard to fiscal years and shall not be subject to the provisions of Section 16304 of the Government Code.

"Sec. 3. Section 15 of the Flood Control Act of 1946 is hereby repealed.

"Sec. 4. This act is hereby declared to be an urgency measure necessary for the immediate preservation of the public peace, health or safety within the meaning of Section 1 of Article IV of the Constitution and shall therefore go into immediate effect. A statement of the facts constituting such necessity is as follows:

"The appropriation hereby reappropriated became available for expenditure March 12, 1946, but questions of interpretation of the act, its insufficiency to include other than strictly flood control surveys, the infeasibility of making surveys in many areas without including multiple use of water supplies involved and lack of available man power due to postwar conditions has necessitated postponement of other than very limited disbursements. It is necessary that this act go into effect immediately in order that further delay may be avoided in planning water supply projects which are urgently needed for the maintenance, growth, and development of the areas benefited, in order to enable immediate preparations for commencement of work under favorable springtime weather conditions and in order to avoid postponement of field work until the imminence of unfavorable weather conditions."

RELATED INVESTIGATIONS AND REPORTS

Development of water resources in California received its greatest impetus from the rapid advance of irrigated agriculture during the decade following 1910. The State Legislature recognized the need for coordinated planning, and in 1921 appropriated funds for comprehensive water resources investigations. That authorization, and subsequent appropriations in 1925 and 1929, resulted in the development of the State Water Plan, presented in Bulletin No. 25 of the Division of Water Resources, entitled "Report to the Legislature of 1931 on State Water Plan." The plan consisted of a number of individual projects which, in the aggregate, constituted a pattern for the coordinated conservation, control, and utilization of the water resources of the State. The major proposals of the State Water Plan were the Central Valley Project, now nearing completion, and the Colorado River development of the Metropolitan Water District of Southern California.

Although the State Water Plan was intended to be comprehensive and state-wide in scope, it was never completed as planned. Further investigations and studies were practically suspended during the depression and war years from 1931 to 1945. Realizing the need for renewed planning, the Legislature in 1945 created the State Water Resources Board, and in the following year passed the Flood Control Fund Act of 1946. On recommendation of the State Water Resources Board, the Legislature in 1947 provided initial funds for a comprehensive program of water resources investigations to be conducted by the State Engineer. The objective of these investigations is the preparation of a plan for maximum conservation, control, protection, and utilization of the State's water resources, both surface and underground, to meet present and future water needs for all beneficial purposes in the entire State. This plan, since it is to be of state-wide scope, has been designated "The California Water Plan." To insure the continued progress of the comprehensive investigations for The California Water Plan the Legislature has provided additional funds by regular budgetary appropriations.

A fundamental link between the state-wide investigation and the Survey of Mountainous Areas is established by legislation enacted in 1931 and now contained in the Water Code as Sections 10500 to 10506, inclusive. These sections are now commonly referred to as the "Counties of Origin Act." Under the provisions of these sections of the Water Code, the State Department of Finance has filed applications to appropriate water at various points in the Feather, Yuba, Bear, American, Cosumnes, Mokelumne, Calaveras, Stanislaus, and Tuolumne River basins, and on Littlejohns Creek within the area under investigation.

Sections 10504 and 10505 of the Water Code provide as follows:

> "10504—The Department of Finance may release from priority or assign any portion of any appropriation filed by it under this part when the release or assignment is for the purpose of development not in conflict with such general or coordinated plan (the State Water Plan).
>
> "10505—No priority under this part shall be released nor assignment made of any appropriation that will, in the judgment of the Department of Finance, deprive the county in which the appropriated water originates of any such water necessary for the development of the county."

The powers of the Water Project Authority for the construction and operation of the Central Valley Project are limited in similar manner by Sections 11460 and 11463 of the Water Code. It is clear that a fundamental prerequisite to the formulation of The California Water Plan is the evaluation of the ultimate water requirements of the "Counties of Origin."

Progressing concurrently with the state-wide investigation are a number of special investigations being conducted under the direction of the State Water Resources Board in cooperation with local agencies. Two of these investigations cover areas partially in and adjacent to the area under investigation in this bulletin. They are interdependent, therefore, with the Survey of Mountainous Areas, and data collected in connection with them have been utilized herein. State Water Resources Board Bulletin No. 6, "Sutter-Yuba Counties Investigation," was published in September, 1952. The others, now completed, are the Placer County Investigation and the San Joaquin County Investigation. Drafts of the reports covering these investigations, Bulletins Nos. 10 and 11, respectively, were furnished to concerned local interests in 1954 for their review and comments.

SCOPE OF INVESTIGATION AND REPORT

The primary objectives of the Survey of Mountainous Areas are the establishment of maximum future water requirements and the development of plans for projects which will satisfy those requirements. To attain these objectives, the investigation embraced a survey of the location, type, and extent of all lands suitable for irrigation, a determination of present land use and present water utilization, estimates of ultimate water requirements both for agricultural and urban areas, a survey of the water resources of the area, and consideration of alternative plans for project development. Field work and office studies were initiated in 1947, and continued into 1954.

A detailed land classification and land use survey was undertaken at the outset of the investigation and was completed in three years. By field examination of such factors as depth and type of soil, slope, and drainage, all lands suitable for irrigation, either developed or potentially capable of development, were classified and delineated on aerial photographs. The survey, covering an area of almost 6,000 square miles, is fundamental to the determination of present and ultimate water utilization, the establishment of water service areas, and the planning of reservoirs and distribution systems.

Estimates of present and ultimate water utilization required studies of consumptive use of water by various crops, and estimates of present and ultimate urban population. The procedure followed in making consumptive use estimates was checked by field studies of test plots in Placer County.

Numerous field surveys of dam and reservoir sites were conducted, involving plane table and photogrammetric mapping and geologic examinations. Reconnaissance surveys were made of possible conduit routes from points of storage to points of use.

A comprehensive survey of the water resources in and available to the area was conducted in order to determine the best sources of water supply for the various water service areas. In addition to study and analysis of available stream flow records, the work required the development of methods of estimating runoff at numerous points remote from existing gaging stations. The development of project plans involved general operational studies of reservoirs, power plants, and conveyance systems.

Results of the Survey of Mountainous Areas are presented in the four ensuing chapters. Chapter II, "Water Supply," contains data and evaluations of precipitation and runoff. Chapter III, "Water Utilization and Requirements," contains data and estimates pertaining to land classification, water service areas, present and future land use, and present and future water utilization. Chapter IV, "Plans for Water Development," describes preliminary plans for conservation and utilization of available water supplies to meet probable ultimate water requirements. Chapter V comprises a summary and a broad evaluation of the studies and analyses presented in Chapters II, III, and IV.

Plans for water development in the area under investigation in this bulletin will be later presented as parts of the forthcoming California Water Plan.

AREA UNDER INVESTIGATION

The area under investigation embraces the mountain and foothill areas of the west slope of the central Sierra Nevada, including all of Amador, Calaveras, Mariposa, and Tuolumne Counties; major portions of Butte, El Dorado, Nevada, Placer, and Yuba Counties; and minor portions of Merced, Sacramento, San Joaquin, and Stanislaus Counties. The area extends from the north boundary of Butte County to the south boundary of Mariposa County. The east boundary of the area is the Sierra Nevada divide, except where the divide enters Alpine, Sierra, and Plumas Counties. In these localities the east boundary of the area coincides with the west boundary of those counties. The western limit of the area is defined generally as the boundary between the Central Valley floor and the foothill areas. This boundary is a meandering line not susceptible to a precise description of its location. The boundary was established, for the most part, on the assumption that the Central Valley floor includes all areas situated below the large multipurpose reservoirs, either existing or proposed for construction, at or near the edge of the valley floor on all of the major streams and on many of the minor streams. Examples of such reservoirs are Exchequer on the Merced River, Folsom on the American River, and Oroville on the Feather River. In localities where possible conduit lines from such reservoirs did not provide logical boundaries according to the fundamental definition, the boundary was established by other means. For simplicity of reference, the area under investigation is designated the "Mother Lode Region." The region is about 200 miles long, has a maximum width of about 98 miles, and embraces a total area of about 11,000 square miles. Its location is indicated on Plate 1, entitled "Location of the Mother Lode Region," and is shown in greater detail on Plate 2, entitled "Water Service Areas and Major Public Water Agencies, 1951."

For project planning purposes, as well as for ease of reference, the Mother Lode Region is divided into two major zones designated as the "national forest zone" and the "agricultural zone." The latter is further divided into 49 water service areas, the boundaries of which are established primarily on the basis of probable sources of water supply and of topographic features controlling the locations of possible canals from points of storage to points of use. Although the water utilization of the national forest zone is given consideration, this area is not divided into service areas because large-scale developments, requiring water supply projects of substantial proportions, are not foreseen for the zone. Instead, it is believed that such water as will be required will be obtained largely by local developments serving areas of limited extent. The boundaries of these zones and service areas are indicated on Plate 2. A detailed description of each service area, covering its location, climate, physical features, present development, and sources of present water supply, is presented in Appendix A.

Physiography and Climate

With elevations ranging from 100 feet to more than 13,000 feet above sea level, the Mother Lode Region experiences wide variations in topography. The terrain changes from nearly flat along the edge of the Central Valley floor to rolling and hilly in zones of moderate elevation, and becomes rugged and mountainous at the high elevations. Many streams cut the area from east to west, the major watercourses being deeply intrenched with narrow floodplains. In many cases, the ridges between major streams are relatively broad, with moderate slopes and fairly deep soils.

The rolling foothills in the western part of the region are characterized by large areas of open grassland, interspersed with zones of scrub oak and brush. The mountainous eastern portions of the region are generally heavily forested with the typical Sierra conifers. At the highest elevations, large areas of bare granitic rocks are common, and numerous glacial lakes exist. Above the 3,500- to 4,000-foot level, virtually all of the region is within national forest boundaries.

Due to the great variation in elevation of the Mother Lode Region there are great differences in climate. The foothill zones normally experience very hot and dry summers and mild winters, while the higher central zone is characterized by moderate summers and cold winters. Above the 5,000-foot level, winters are long and usually quite severe, with heavy snowfalls being the rule. Due to the influence of variable topography on such factors as humidity, winds, exposure, and air drainage, climatic conditions may vary substantially within very short distances. An example of such a condition is the five-degree difference in mean annual temperatures at Grass Valley and Nevada City. The two towns are located about five miles apart at the same elevation and with equal precipitation. Variation in climate causes considerable differences in the length of the growing season in the region. Within the agricultural zone the growing season varies generally from four and one-half months at the highest elevations to nine months at the lowest elevations.

Tributary Streams

The primary drainage system of the Mother Lode Region consists of seven major streams which head at the crest of the Sierra Nevada and flow generally westward to the Central Valley floor where they empty into the Sacramento River or into the San Joaquin River. Numerous minor streams drain smaller watersheds of low to moderate elevation located between the lower basins of the major streams.

From north to south, the major streams of the region are the Feather, Yuba, American, Mokelumne, Stanislaus, Tuolumne, and Merced Rivers. Of these streams, the first three named are tributary to the Sacramento River, while the others empty into the San Joaquin. On the basis of areas tributary to the Sacramento and San Joaquin Rivers, respectively, the Mother Lode Region may be divided conveniently into northern and southern sections.

Many of the minor streams empty into major streams beyond the west boundary of the region, while others discharge directly into the Sacramento or San Joaquin River. A few of the minor streams drain into the tidal channels of the Sacramento-San Joaquin Delta. The most important of the minor streams are Bear River and Butte Creek in the northern part of the region, and the Cosumnes and Calaveras Rivers in the southern section.

Geology

The adaptability of soils for agricultural use is determined in part by the nature of the geological materials from which they are derived. The ensuing description of the geology of the Mother Lode Region serves as a basis for subsequent discussion of the soils of the region with respect to their origin, classification, and suitability for agricultural development. An understanding of the geology is also essential in evaluating conditions at proposed dam sites in the region; in addition, quality of water is largely determined by the composition of rock formations with which the water comes in contact.

The Sierra Nevada is essentially a tilted block having a steep eastern face and a gentle western slope. Topography is rugged in the vicinity of deeply incised stream canyons. However, in areas at some distance from those streams it is moderately rolling or in places nearly flat. The areas of low relief are remnants of an old erosion surface into which the stream system is now actively cutting. The Sierra Nevada block within the limits of the Mother Lode Region is composed principally of steeply dipping meta-sediments and associated igneous and meta-igneous rocks on the flanks of the granitic core of the range. Dip of the meta-sediments is generally eastward and averages about 70 degrees. Tertiary volcanic rocks, including both flows and pyroclastics, overlie the older rocks. Gently dipping Tertiary sediments overlie the lower slopes of the block and farther west pass beneath the more recent alluvium of the Central Valley. Strike of the older rocks in the Sierra Nevada block is northwesterly, generally parallel to the range itself, and in places tributary streams flow through valleys developed along that strike. The tilt of the Sierra Nevada block is the result of vertical movement of many thousands of feet along the eastern face of the range.

An outstanding geological feature of the region is the famous Mother Lode, a mile-wide belt of gold-bearing quartz veins extending for a distance of about 120 miles through the lower mountain zones of Mariposa, Tuolumne, Calaveras, Amador, and El Dorado Counties. From south to north, the Mother Lode passes through or near the towns of Mariposa, Jamestown, Angels Camp, San Andreas, Jackson, Sutter Creek, Plymouth, Placerville, and Georgetown. Gold was discovered in the Mother Lode in 1849, and within a few years the great mining boom was on.

Pre-upper Cretaceous rocks forming the Sierra Nevada block are referred to as the "Bedrock series," as opposed to the "Superjacent series" deposited on parts of the block after the intrusion, folding, and faulting of the late Mesozoic era. The Bedrock series is composed of a number of more or less distinct geological formations hereinafter described.

The Calaveras formation is a thick series of metamorphosed sedimentary rocks which include phyllite, quartzite, crystalline limestone, and chert. Green amphibolite schist of contemporaneous age is associated with the formation. Fossils found in the Calaveras have resulted in it being assigned a Carboniferous age, although some sediments both older and younger may be included in it. The Calaveras formation occupies a large area immediately east of the Mother Lode along the entire axis of the area under investigation, and also occupies a long strip along the west flank of the Mother Lode from the latitude of Angels Camp to Colfax.

The Mariposa formation of Jurassic age is composed principally of black slate and graywacke. Interbedded volcanic rocks have been altered to greenstone. The Mariposa rocks have obviously been subjected to a milder degree of metamorphism than those in the Calaveras formation. The Mariposa formation occupies two prominent, slightly irregular, but nearly continuous strips along the western side of the two bands occupied by the Calaveras formation. The eastern strip lies generally along the Mother Lode and includes the famous gold-bearing slates.

Many varieties of igneous rocks older than the main Sierra Nevada granitic batholith occur near the western base of the range. Most widespread of these are amphibolite, porphyrite, and diabase, all of which are sometimes included in the term "greenstone." These rocks, which are somewhat foliated and classified as meta-igneous, occur both interbedded with the Calaveras and Mariposa formations and in broad belts without associated sedimentary rocks. They are of volcanic origin and contain a notable variety of rock types. The amphibolite is usually green, fine-grained, and schistose, and was probably derived principally from augitic tuffs and breccias. The porphyrite and diabase are quite resistant to weathering and erosion. Hills and ridges underlain by the latter rocks include Oregon Hills in Yuba County; Pinon Blanco Ridge and Moccasin Peak in Tuolumne County; Buckhorn and Bullion Peaks in Mariposa County; and Bear Mountain and Gopher Ridge in Calaveras County. The oldest plutonic rocks that invaded the area in probable late Jurassic time were intrusions of peridotite which occur in bodies elongated in the general direction of the regional strike. These rocks have been largely altered to serpentine. A typical area is the Red Hills near Chinese Camp in Tuolumne County.

The main body of Sierra Nevada granodiorite with variations from gabbro to granite is exposed in the higher portions of the Sierra Nevada. Relatively large bodies of granitic rocks also appear in various locations in lower elevations. These acidic intrusive rocks weather and erode easily, as evidenced by lowland areas developed west of French Corral in Yuba County and the Rocklin area in Placer County, and by stream valleys developed on the Tuolumne River near Don Pedro Bar and on Stanislaus River northwest of Columbia.

Sediments of late Cretaceous, Tertiary, and Quaternary age overlie the western portion of the steeply dipping, folded Bedrock series with marked unconformity. Igneous rocks of contemporaneous age overlie portions of the main Sierra Nevada granitic batholith. These rocks have been termed the Superjacent series.

The Chico formation, composed of clastic sedimentary rocks of upper Cretaceous age, is the oldest of the Superjacent series and appears only in stream valleys in northern Butte County in the area under investigation in this bulletin.

The Ione formation of the Eocene is next in age to the Chico formation, and consists of clays, clayey sandstones, shale, and some lignite laid down near the shore of the sea which occupied the Central Valley in early Tertiary time. These deposits lie to the west of the Bedrock series and extend in a northwesterly-trending strip running through Ione and Michigan Bar. Auriferous gravels were laid down in stream channels in the Sierra Nevada block proper during the Tertiary period. These gravels are in part Eocene in age and in part younger. In many places these deposits have been preserved under a capping of later volcanics. Overlying the Ione formation and hence forming the surface material immediately west thereof is the Valley Springs formation of Miocene age, composed principally of clay and conglomerate derived from rhyolitic material and rhyolitic tuff.

Next in age is the Mehrten formation, composed of sediments dominantly andesitic in composition. It appears on the surface along a belt lying west of the outcrop of the Valley Springs formation. It is of Miocene and/or Pliocene age, and neither it nor the Valley Springs formation is in evidence north of the latitude of the American River.

Unconsolidated deposits of the Pliocene and Pleistocene occur along the east side of the Sacramento Valley, generally west of the area under investigation in this bulletin. Recent alluvial deposits occurring along the principal axis of the Central Valley extend, together with the Plio-Pleistocene alluvium, into the area under investigation to a minor extent along major streams and in a few isolated small valleys.

Volcanic activity of the Tertiary period covered much of the Sierra Nevada block with rhyolitic material and later with andesitic deposits, remnants of which commonly overlie the main mass of Sierra Nevada granitics or the Calaveras formation. Transportation and deposition of this material along the base of the Sierra Nevada led to formation of the Valley Springs and Mehrten formations. A few Tertiary basalt flows are preserved on the western Sierra Nevada slope in the vicinity of Jamestown in Tuolumne County and Oroville in Butte County.

There are a number of other geological formations of small areal extent generally near the crest of the Sierra Nevada or in the extreme northern part of the region, which are of no importance to its agricultural economy. These include Cenozoic volcanics, Jura-Trias meta-volcanics (including the Sailor Canyon formation), Paleozoic meta-volcanics, Triassic meta-sediments and Paleozoic meta-sediments other than the Calaveras formation.

The geological formations of the Mother Lode Region are delineated on the State Geological Map prepared by the Department of Natural Resources, Division of Mines. They are shown in more detail in various folios of the United States Geological Survey.

Soils

A cooperative program of soil surveys, between the Bureau of Plant Industry of the United States Department of Agriculture and the College of Agriculture of the University of California, has been in existence for many years. Under this program most valley lands of the State have been mapped and many soil series and types classified. However, in the Mother Lode Region soil surveys have been conducted on foothill and mountainous agricultural lands only in the vicinity of Placerville, Auburn, and Grass Valley. The eastern fringe of some of the Sacramento and San Joaquin Valley surveys extends into the lower portion of the region.

Soils in the Mother Lode Region are closely related to the parent geological material from which they have been formed. It is possible through use of the geological map of the area to determine general soil series-groups based on parent geologic material and the rainfall zone in which the soil occurs. By definition, a soil series-group is composed of a number of soil series which have similar major physical characteristics and whose formation was influenced by common soil-forming factors. The list of the adopted soil series-groups in California and the various soil series included in the groups may be found by referring to "Manual for Identifying and Classifying California Soil Series," by R. Earl Storie and Walter W. Weir, published in 1948 by the Associated Students Store of the University of California.

Soils may be divided into two categories, called primary or residual soils and secondary soils. Residual soils are those which have been formed in place from underlying bedrock through action of weathering and other soil-forming processes. These residual soils may be further divided according to the nature of the parent material into three groups, as follows: soils developed from basic igneous rocks which have only a small amount of free quartz; soils developed from quartz-bearing acid-igneous rocks; and soils developed from sedimentary rocks of mixed origin. Secondary soils are those which have been transported from their place of formation by the process of erosion and redeposited in a new locality. They vary in age from recent alluvial deposits to old valley fillings which have undergone considerable development since having been laid down.

Soils of the greater part of the Mother Lode Region are residual and, therefore, may be assigned an appropriate series-group by reference to the geological map. Soils formed on any of the Bedrock series of rocks and on the older more consolidated rocks of the Superjacent series are primary soils. Secondary soils are found along the western edge of the area in the Pliocene, Pleistocene, and Recent alluvial deposits, except that an occasional small valley in the foothill areas along an active stream may contain secondary soils on its flood plain. On Plate 3, entitled "Soils of the Mother Lode Region," are shown the general locations of the soil series-groups.

Residual soils derived from coarse-textured, acid-igneous, granitic rocks are placed in the Holland series-group. These soils have developed on the granitic core of the Sierra Nevada under intermediate to high rainfall. Native vegetation is dominantly timber or timber-grass, topographic conditions are rolling to steeply rolling with smooth surfaces except where broken by erosion or rock outcroppings, and drainage is good to excessive. Parent material forming the Holland series-group gives rise to soils that have excellent physical characteristics. They are mainly of coarse to medium texture, in which sandy loam and loam types predominate, and have a soft cloddy to granular structure. The soils contain no lime, are slightly to strongly acidic in reaction, low in organic matter, and, despite inherent productive deficiencies, respond favorably under good management. Their poor water-holding capacity makes them generally undesirable for shallow-rooted crops.

Residual soils derived from fine-textured basic igneous rocks include the Aiken, Auburn, and Montara series-groups. The Aiken series-group has developed principally on Tertiary volcanics and Jurassic meta-volcanics in the higher elevations, under timber cover with intermediate to high rainfall. Soils are generally fine-textured, topographic conditions are rolling to steeply rolling, and drainage is generally good, except in local flat or depressed areas. The Auburn series-group has developed principally on meta-volcanics of Jurassic time which occur along the western part of the area paralleling the Mother Lode under an intermediate rainfall on rolling to steep topography. Vegetation is mainly scattered oak and grass. Drainage is generally good, although local flats or depressed areas are subject to seepage and retarded drainage.

Soils developed from these basic igneous rocks are low in silica and high in calcium and magnesium, and have favorable chemical characteristics. These soils are of medium to fine texture, in which clay and silty clay loam types predominate, and have a good water-holding and high base exchange capacity. The Aiken series-group, containing the typical red soils of the foothills, consists of deeper soils than the Auburn series-group, and is better suited for the production of deep-rooted orchard crops. The Auburn series-group contains the distinctive "tombstone rock" outcroppings of the amphibolite schist, and, in the northern part of the area, the nonagricultural volcanic mudflows. Permanent pasture, such as ladino clover or mixed grasses, can be produced on Auburn and Aiken series-group soils.

The Montara series-group has developed in place on serpentinized rocks, under variable rainfall, on rolling to steep topography. Vegetation is brush or brush-grass, and drainage is good. These soils have unfavorable chemical characteristics and have, at the present time, little agricultural value.

Residual soils derived from consolidated or partially consolidated sedimentary rocks include the Hugo, Vallecitos, and Goldridge series-groups, and include a wide variety of soils derived from the Mariposa and Calaveras formations and from the partially consolidated Eocene and Miocene deposits.

The Hugo series-group has been developed on shales and slates under intermediate to high rainfall, on rolling to steep topography. Vegetation is mainly grass, and surface drainage is good to excessive. These soils are shallow, particularly in the lower elevations, and are probably best suited for development of permanent irrigated pasture. In the lower elevations, where rainfall and weathering are lighter, these soils contain considerable slaty rock outcropping. However, owing to the fractured nature of the bedrock, some of the deeper soils probably could be used for vineyards and shallow-rooted orchard crops where other conditions are favorable. In areas where meta-volcanics are interbedded with the Calaveras and Mariposa formations the Hugo and Auburn series-groups occur in close proximity. Where these conditions exist, Hugo and Auburn soils are shown on Plate 3 by a separate convention which may be termed the Auburn-Hugo complex. Similarly, both Hugo and Auburn soils will be found intermingled in areas which are shown on Plate 3 as predominately in the Aiken series-group.

The Vallecitos series-group of soils has developed from softly to moderately consolidated mixed sediments of the Mehrten and Ione formations, under intermediate rainfall, on rolling to steep topography. Drainage is good to excessive, and natural vegetation is oak-grass. The Goldridge series-group of soils has developed from softly consolidated deposits of tuffaceous material of the Valley Springs formation under intermediate rainfall, on rolling to steep topography. Natural vegetation is grass, and drainage is good to excessive.

The Vallecitos and Goldridge series-groups of soils are shallow, but, owing to the unconsolidated nature of their subsoils, root growth is not obstructed. They contain a wide variety of soil series of extremely variable agricultural value in a complex erosional pattern, and are overlain in many local areas by later secondary soils of the San Joaquin, Corning, and Redding series-groups. This soil complex is delineated under a single convention on Plate 3. These soils are predominately of the more infertile types, typified by the "haystack mountain" topography and white sands of the Ione formation. The largest area of agricultural importance is in the Jackson and Ione Valleys of Amador County. North of the American River the covering of secondary soils becomes nearly continuous. The better soils in this complex

Modern Lumbering in Amador County

Courtesy of State Division of Highways group within the region are now utilized for the production of dry-farmed olives, some almonds, and grain. Irrigation is practiced where water is available.

Secondary soils developed from mixed alluvium occupy the entire floor of the Sacramento and San Joaquin Valleys, and extend into the Mother Lode Region only along its extreme western margin and along alluvial plains bordering major streams. Soils that have developed on old plain and terrace sediments, originating from various rock sources of both the Bedrock and Superjacent series, include the Redding, San Joaquin, Corning, Stockton, and Keefers series-groups. These soils have been maturely weathered and modified in place subsequent to deposition, under light and intermediate rainfall, and have developed a more or less firmly cemented hardpan or accumulation of heavy clay in the subsoil. Natural vegetation is brush and grass, and drainage is slow in the subsoil. These soils are usually of little value for any use other than pasture. The Columbia and Vina series-groups represent recent alluvial soils. They are found along flood plains of the principal streams in the Central Valley, generally below the base of the foothills. They extend into the region to a minor extent along the watercourses, but in most instances their agricultural value has been destroyed by extensive placer mining operations. All secondary soil series-groups are shown on Plate 3 under a single convention.

Present Development

Development of the Mother Lode Region began in 1848 with the discovery of gold at Sutter's Mill, near the town of Coloma on the South Fork of the American River. The mining boom which followed reached tremendous proportions, and resulted in rapid development of lumbering and agriculture, and a large growth in population. The advent of hydraulic mining led to the construction of numerous reservoirs and hundreds of miles of canals and ditches to provide the water needed for gold-mining purposes. With a water supply of some dependability available from the mining ditches, irrigated agriculture developed into an important activity. Within a period of 20 years after the beginning of the gold rush, the Mother Lode Region achieved its peak development. With the subsequent decline in gold mining, the region entered a period of recession which continued until the end of World War I. Since that time the region has been on the rise again, but its rate of growth since World War II does not approach that of the rest of the State. The rise and decline of the region and its subsequent upswing are illustrated by comparative population figures for the six counties which lie almost completely within the boundaries of the Mother Lode Region. These figures are given in Table 1.

TABLE 1
POPULATION TRENDS IN SIX COUNTIES, MOTHER LODE REGION

County	Population					
	1860	1880	1900	1920	1940	1950
Amador	10,903	11,384	11,116	7,793	8,973	9,151
Calaveras	16,299	13,118	11,200	6,183	8,221	9,902
El Dorado	20,562	10,683	8,986	6,426	13,229	16,207
Mariposa	6,243	4,339	4,720	2,775	5,605	5,145
Nevada	16,446	20,823	17,789	10,850	19,283	19,888
Tuolumne	16,229	7,848	11,166	7,768	10,887	12,584
TOTALS	86,709	68,195	64,977	41,795	66,198	72,877

The population of the region is predominantly rural in character. The largest towns in the region are Oroville and Grass Valley, with populations of 5,387 and 5,283, respectively, according to the 1950 census. There were only five other towns in the region with populations of 2,500 or more.

Within recent years a new type of settlement has begun in the region and is increasing steadily. Where water is available, people are developing small tracts to grow fruits and garden vegetables, and supplementing their incomes by part-time employment in lumbering, mining, or tourist-catering enterprises. Retired people are being attracted to the region by its desirable climate and scenic beauty, and many are settling on small tracts along the important scenic highways. Impressive evidence of such developments may be found in the Paradise area of Butte County and along U. S. Highways 50 and 40 in El Dorado and Placer Counties.

Transportation facilities vary from excellent to poor in different parts of the region. The region is crossed by two major transcontinental railroads, the Southern Pacific and Western Pacific, and there are several branch railroads in various localities. Most of the region, however, has no direct rail service. U. S. Highways 40 and 50, with all-year roads, cross the Sierra Nevada in the central part of the region, and several state roads cross in other sections. The latter are usually closed by snow at the high elevations during the winter months. Many localities are served only by county roads of limited utility.

The economy of the Mother Lode Region is founded on four basic industries — lumbering, hydroelectric power generation, agriculture, and mining. Basic economic activities of lesser importance are tourist and recreational trades and manufacturing.

The lumber industry has been a major activity in the Mother Lode Region since the days of the gold rush, and has experienced a substantial expansion in recent years to satisfy the accelerated demands for timber products brought about by World War II and by the subsequent rapid increase in the population of California. Many of the best timber areas have been logged off, however, and it appears now that the in-

Central Eureka Gold Mine, Amodor County

Courtesy of Amodor County Chomber of Commerce dustry will stabilize itself eventually on the basis of long-range, sustained yield operations within the national forest reserves. The future of the industry appears to be one of stabilization rather than one of expansion.

The generation of hydroelectric power is of major significance in the Mother Lode Region, and has increased substantially over the years to satisfy the demands for power brought about by the increase in the population of California. The combination of available runoff and favorable elevations in the region has made possible the development of this power. Although it is probable that the available water supply will ultimately serve a combination of beneficial uses, it is also probable that a considerable further expansion in hydroelectric development may be expected.

During the great mining boom, high prices for food caused a rapid development of agriculture in the Mother Lode Region, principally serving local markets. However, the decline in mining activities which occurred after the boom period resulted in a substantial decrease in population, and local markets for agricultural products suffered a corresponding deterioration. Although attempts were made to develop markets outside the region, the farmers in the foothill areas were unable to compete with those on the Central Valley floor who enjoyed such important advantages as low cost and plentiful water supplies, highly productive land, longer growing seasons, and ready access to markets. This unfavorable economic position resulted in the curtailment of agricultural activity in the Mother Lode Region, notably in the growing of such market crops as were also grown in valley floor areas. Cattle raising and fruit growing, for which the region offered particular advantages, eventually became the dominant activities in the reduced agricultural economy, and they remain so to this day. According to a survey conducted for this investigation during 1948 through 1950, less than 10 per cent of the irrigable land in the region was being irrigated. The survey revealed a total irrigated area of some 63,000 acres, more than 85 per cent of which are in the northern half of the region. An additional area of about 57,000 acres was dry-farmed. Orchards and pasture accounted for virtually all of the irrigated crops, while the bulk of the dry-farmed land was planted in grain hay. Although agriculture is one of the three foremost economic activities in the Mother Lode Region, its present development is only a small fraction of the potential development which could be realized if dependable water supplies were made available at reasonable cost.

Gold mining is still an industry of importance in the region, but present production does not approach that of the past. Legislation and court decisions limiting the disposal of debris in rivers and streams have virtually halted hydraulic mining. Many of the great lode mines and underground placer works which closed down during World War II have been unable to resume operations on a profitable basis due to increased costs of production and to federal regulation of the price of gold. Among other minerals produced in the region are copper, limestone, chromite, and slate. It is possible that a substantial increase in mining development could occur as a result of future economic conditions. In any event, mining is expected to retain its place as one of the basic industries of the region.

The climate and the great scenic beauty of the Mother Lode Region have led to the development of many recreational and resort areas, of which Yosemite National Park is world famous. The equally famous Lake Tahoe area is just beyond the eastern boundary of the region, and numerous state parks and national monuments exist. The variety of facilities offering all types of winter and summer sports has made the region one of the foremost recreational areas in America. Tourist-catering enterprises have become an important economic activity in the region.

Among the smaller industries are food-processing plants, principally in the Auburn and Placerville areas of Placer and El Dorado Counties, a large cement plant near San Andreas in Calaveras County, and a clay products plant at Lincoln in Placer County.

The relative importance of the basic industries of the Mother Lode Region is indicated by a comparison of the dollar value of production for the calendar year 1949. Figures for the six counties which are completely, or very nearly completely, within the boundaries of the region are listed in Table 2.

TABLE 2

ESTIMATED VALUE OF 1949 PRODUCTION BY BASIC INDUSTRIES IN SIX COUNTIES, MOTHER LODE REGION

(In dollars)

County	Lumbering	Agriculture	Mining
Amador	4,120,000	2,095,000	905,000
Calaveras	7,150,000	2,095,000	5,047,000
El Dorado	12,150,000	3,632,000	1,550,000
Mariposa	1,760,000	1,756,000	326,000
Nevada	3,790,000	1,407,000	4,034,000
Tuolumne	10,660,000	2,295,000	784,000
TOTALS	39,630,000	13,280,000	12,646,000

Values of agricultural production shown in the table are taken from reports of the California Crop and Livestock Reporting Service. The figures represent cash farm income. The data given for mining production represent gross income, as reported by the Mineral Information Service of the California Department of Natural Resources, Division of Mines. Values of lumber production were computed by applying estimated dollar values to the lumber cut, as reported by the California Forest and Range Experiment Station at the University of California. The figures given in the table represent the value of rough lumber at the sawmill. Values added by milling and finishing are not included.

The tabulation indicates clearly the leading position of the lumbering industry in the present economy of the Mother Lode Region. It is believed, however, that agriculture offers the greatest opportunities for expansion, and that it may eventually supersede lumbering as the number one economic activity of the region.

CHAPTER II
WATER SUPPLY

The water supply of the Mother Lode Region largely occurs as precipitation and ensuing surface runoff. Because of its limited occurrence, ground water is not considered a significant resource of the region. However, in many places small water supplies are obtained from individual shallow wells for domestic and stockwatering purposes, and in some localities water is pumped from wells for minor irrigation use. Ground water basins within the region are of only local significance and very limited in potential yield. For this reason, it is considered that under ultimate development all irrigation water requirements will be satisfied in part by direct precipitation on the irrigable lands and in part by surface diversion from streams and reservoirs. No attempt is made, therefore, to evaluate such ground water resources as may exist in the region as a potential source of water supply.

In this chapter, the water supply of the Mother Lode Region is considered and evaluated under the general headings "Precipitation," "Runoff," and "Quality of Water." Terms used in the discussion are defined as follows:

Annual—This refers to the 12-month period from January 1st of a given year through December 31st of the same year, sometimes termed the "calendar year."

Seasonal—This refers to any 12-month period other than the calendar year.

Precipitation Season—The 12-month period from July 1st of a given year through June 30th of the following year.

Runoff Season—The 12-month period from October 1st of a given year through September 30th of the following year.

Mean Period—A period chosen to represent conditions of water supply and climate over a long period of years.

Mean—This is used in reference to arithmetical averages relating to mean periods.

Average—This is used in reference to arithmetical averages relating to periods other than mean periods.

Natural Runoff (Flow)—The flow of a stream as it would be if unaltered by upstream diversion, storage, import, export, or change in upstream consumptive use caused by development. Natural runoff is reconstructed from measured (actual) runoff by allowing for the quantitative effect of alterations in stream flow above the point where the flow is measured.

In studies for the current State-wide Water Resources Investigation, it was determined that the 50-year period from 1897-98 through 1946-47 is the most satisfactory for estimating mean precipitation. Similarly, the 53-year period from 1894-95 through 1946-47 was selected as a basis for estimating mean seasonal runoff. In studies for the Survey of Mountainous Areas, these periods were considered representative of mean conditions of water supply and climate.

PRECIPITATION

The great range in elevation of the Mother Lode Region is the cause of a correspondingly great variation in quantity and type of precipitation. Winter storms moving in from the Pacific Ocean deposit light precipitation as they cross the floor of the Central Valley and begin to lose moisture at increasing rates as they are lifted and cooled in their passage over the Sierra Nevada. Precipitation during the winter months normally occurs as snow above the 5,000-foot contour.

Precipitation Stations and Records

There are 153 precipitation stations in and adjacent to the Mother Lode Region with unbroken records of 10 years' duration or longer. These stations are located on Plate 4, entitled "Lines of Equal Mean Seasonal Precipitation, 1898-1947." Map reference numbers correspond to those used in State Water Resources Board Bulletin No. 1, "Water Resources of California." Detailed information concerning these stations is contained in Table 1 of Appendix B. The table lists the stations and map reference numbers, together with elevations of the stations, periods and sources of record, and the mean, maximum, and minimum seasonal precipitation. For stations with less than 50 years of record, the mean seasonal precipitation was estimated by comparison with the nearest station having 50 years or more of record.

The isohyetal map of the Mother Lode Region and adjacent areas shown on Plate 4 is based on the mean seasonal precipitation of stations with 10 or more years of record. Stations with less than 10 years of record were not used in the construction of this map because it was considered that reliable estimates of mean seasonal precipitation can be made only for stations with at least 10 years of record. In general, the coverage furnished by precipitation stations is adequate, but in certain areas, such as the upper basins of the American and Tuolumne Rivers, additional stations are needed.

Precipitation Characteristics

In the Mother Lode Region precipitation increases generally with latitude and with elevation. Due to the orographic effect of the Sierra Nevada, however, maximum precipitation along any line of latitude occurs at a point some distance below and to the west of the main crest of the Sierra Nevada. Beyond these points, precipitation decreases rapidly. Along the western boundary of the region, mean seasonal depth of precipitation varies from about 13 inches at the extreme southern limit to about 30 inches at the northern limit. The elevation of both of these points is about 500 feet above sea level, but there is a difference in latitude between the two points of 2.7 degrees. Mean seasonal precipitation reaches a maximum of 90 inches of depth at a point in Butte County between the North and Middle Forks of Feather River. Maximum seasonal depth of precipitation in the southern part of the region is about 70 inches.

Although there may be considerable variation in quantity of precipitation within relatively short distances, the over-all characteristics of precipitation are essentially the same in all parts of the region. The general increase in precipitation with increases in elevation and latitude is shown by the isohyetal lines on Plate 4. Other similarities are indicated by Plates 5 and 6. Plate 5, entitled "Accumulated Departure From Mean Seasonal Precipitation at Sonora and Nevada City," presents graphs for the United States Weather Bureau stations at Nevada City in the northern part of the region, and at Sonora some 100 miles to the south. The graphs indicate the similarity of wet and dry periods and of seasonal precipitation ratios at different latitudes. In specific years, it would not be unusual for precipitation to be below normal at one station and above normal at another. Such occurrences are the exceptions, however, to the general conditions of similarity.

The normal occurrence of precipitation throughout the year is shown on Plate 6, entitled "Monthly Distribution of Mean Seasonal Precipitation at Selected Stations." Data are presented for the Weather Bureau station at Kennedy Mine in Amador County, as well as for the stations at Nevada City and Sonora. About 80 per cent of the seasonal precipitation at all three stations occurs during the five months from November 1st through March 31st. The similarity in the normal occurrence of precipitation at the three stations is established clearly by the fact that the three curves on Plate 6 are almost identical.

Precipitation in the Mother Lode Region varies widely from season to season. This variation is illustrated by Plate 5, and is indicated in more detail in Table 3, which lists the historical seasonal precipitation at Nevada City. Precipitation has been measured continuously at the Nevada City station since 1863. Maximum seasonal precipitation occurred in 1867-68, when a depth of 115.26 inches was recorded. Precipitation during 1863-64, the minimum season at this station, was only 17.28 inches. Seasonal precipitation at Nevada City has ranged from 33 per cent to 223 per cent of the average during the 88-year period 1863-64 through 1950-51.

TABLE 3

RECORDED SEASONAL PRECIPITATION AT NEVADA CITY

(In inches of depth)

Season	Precipitation	Season	Precipitation	Season	Precipitation
1863-64	17.28	1894-95	68.79	1924-25	46.78
		95-96	58.31	25-26	42.32
1864-65	54.56	96-97	53.18	26-27	60.65
65-66	59.26	97-98	29.70	27-28	43.73
66-67	81.56	98-99	38.62	28-29	33.12
67-68	115.26				
68-69	56.69	1899-1900	56.09	1929-30	43.27
		00-01	53.07	30-31	30.21
1869-70	48.61	01-02	49.99	31-32	51.68
70-71	45.38	02-03	46.43	32-33	31.84
71-72	78.22	03-04	65.88	33-34	36.62
72-73	38.70				
73-74	62.91	1904-05	52.03	1934-35	55.90
		05-06	67.42	35-36	61.44
1874-75	45.95	06-07	70.98	36-37	51.00
75-76	66.67	07-08	35.48	37-38	76.28
76-77	32.31	08-09	62.57	38-39	28.92
77-78	57.15				
78-79	58.88	1909-10	44.64	1939-40	60.40
		10-11	70.54	40-41	75.25
1879-80	62.97	11-12	28.77	41-42	68.99
80-81	57.87	12-13	36.19	42-43	58.29
81-82	43.51	13-14	61.18	43-44	32.94
82-83	48.70				
83-84	61.34	1914-15	56.32	1944-45	52.59
		15-16	53.88	45-46	48.97
1884-85	44.88	16-17	39.90	46-47	34.69
85-86	65.78	17-18	30.85	47-48	51.10
86-87	37.38	18-19	44.76	48-49	43.49
87-88	35.42				
88-89	43.86	1919-20	33.12	1949-50	51.23
		20-21	60.37	50-51	71.45
1889-90	100.17	21-22	52.42		
90-91	38.56	22-23	47.71	Mean for 50-year period 1897-98 through 1946-47: 48.74	
91-92	44.88	23-24	22.25		
92-93	65.88				
93-94	49.35			Average for 88-year period of record, 1863-64 through 1950-51: 51.75	

RUNOFF

The runoff of the rivers and streams of the Mother Lode Region is the primary source of water supply. No significant ground water supplies exist, and precipitation during the growing season can furnish only a very small fraction of irrigation water requirements. Surface runoff, therefore, is the basic resource that controls the development and growth of virtually all human activities. Authoritative information concerning the quantity and occurrence of surface runoff is indispensable to the planning of any future development which requires a dependable water supply.

Stream Gaging Stations and Records

The flow of Sierra Nevada streams has been measured for many years under a cooperative program of the United States Geological Survey and the Division of Water Resources, and by other public and private agencies. Long-time records are available for stations at or near the edge of the floor of the Central Valley on all of the major streams of the region. Continuous records for these stations cover periods of from 45 to 57 years. Gaging stations have been maintained for shorter periods at numerous points in the upper portions of the major stream basins, on all of the minor streams, and on many canals, flumes, tunnels, and reservoirs. Runoff records of 10 years' duration or longer are available for 188 stations in and adjacent to the region, and records of shorter duration are available for an additional 120 stations. With the exception of those on artificial waterways, all of these stations are identified on Plate 7, entitled "Locations of Stream Gaging Stations, 1952." Map reference numbers correspond to those used in State Water Resources Board Bulletin No. 1, "Water Resources of California." Stations established since publication of the bulletin are numbered according to the same system. Table 2 of Appendix B lists all 308 gaging stations, together with their map reference numbers, drainage areas where pertinent, and periods and sources of records.

Runoff Characteristics

Since the time of occurrence of precipitation is generally the same in all parts of the Mother Lode Region, it follows that any major variation in the regimens of the various streams of the area must be the result of some natural regulatory influence. This regulatory influence exists in the form of snowshed areas, which have a controlling effect on the occurrence of monthly runoff. Snowsheds act as natural reservoirs in storing the winter precipitation, which generally occurs as snow above the 5,000-foot level, and releasing it gradually during the snowmelt period from April through July.

On the basis of snowshed areas, streams of the Mother Lode Region may be classified as major or minor streams. Thus, a major stream heads at the crest of the Sierra Nevada and a substantial proportion of its total watershed area lies above 5,000 feet in elevation. A minor stream heads at intermediate elevations and little or none of its watershed lies above the 5,000-foot contour. Major streams and principal minor streams in and tributary to the Mother Lode Region are listed in Table 4, which also sets forth watershed areas above an elevation of 5,000 feet to indicate the proportions of snow and rain watersheds.

TABLE 4

WATERSHED AREAS ABOVE AN ELEVATION OF 5,000 FEET IN PRINCIPAL STREAM BASINS, MOTHER LODE REGION

Stream and station	Total watershed area, in square miles	Watershed area above 5,000-foot elevation	
		In square miles	In percent of total watershed area
Major streams			
American River at Fair Oaks	1,921	787	41.0
Feather River near Oroville	3,611	1,930	53.4
Merced River at Exchequer	1,035	552	53.3
Mokelumne River near Clements	630	297	47.1
Stanislaus River near Knights Ferry	983	516	52.5
Tuolumne River near La Grange	1,540	907	58.9
Yuba River at Smartville	1,194	515	43.1
Minor streams			
Bear Creek near Planada	164	0	0
Bear River near Wheatland	295	2	0.7
Butte Creek near Chico	148	47	31.8
Calaveras River at Jenny Lind	395	3	0.8
Chico Creek near Chico	68	4	5.9
Chowchilla River at Buchanan dam site	238	5	2.1
Coon Creek at U. S. Highway 99E	84	0	0
Cosumnes River at Michigan Bar	537	88	16.4
Dry Creek near Cooperstown	154	0	0
Dry Creek near Ione	279	0	0
Dry Creek near Waldo	69	0	0
French Dry Creek at Virginia Ranch	72	0	0
Littlejohns Creek near Farmington	213	0	0
South Honcut Creek at La Porte Road	69	0	0

The controlling influence of snowsheds on monthly runoff is illustrated graphically on Plate 8, entitled "Typical Effect of Snowshed Storage on Occurrence of Monthly Runoff." The plate indicates the characteristic difference between the regimens of major and minor streams, so far as monthly flows are concerned.

Runoff characteristics of major streams are generally similar, regardless of geographical location or extent of total drainage area. Melting snow normally sustains the flow until early July, well beyond the end of the rainy season. After the end of the snowmelt period, the flow drops rapidly to low stages and remains there until the advent of the rainy season, usually in October. Normally, the runoff of major streams during the snowmelt months—April through July—varies from about 46 per cent to 68 per cent of the total seasonal runoff, the ratio for any particular stream depending primarily on the extent and elevation of its snowshed area, and to a lesser degree on other physical factors. These ratios are shown in the following tabulation.

Stream and station	*Drainage area above 5,000-foot elevation, in per cent of total drainage area*	*Runoff during April, May, June, and July in per cent of mean seasonal runoff*
Feather River at Oroville	53.4	46.2
Yuba River at Smartville	43.1	50.5
American River at Fair Oaks	41.0	54.3
Mokelumne River near Clements	47.1	68.3
Stanislaus River near Knights Ferry	52.5	67.7
Tuolumne River near La Grange	58.9	68.6
Merced River at Exchequer	53.3	68.7

The higher proportion of runoff during the snowmelt period on streams in the southern part of the region is due primarily to higher average elevation and greater extent of snowshed areas. Elevations along the Sierra Nevada crest are substantially higher in the southern part of the region than in the northern part.

The runoff of major streams varies widely from season to season, more or less directly with seasonal precipitation. This variation is indicated by Plate 9, entitled "Accumulated Departure From Mean Seasonal Natural Runoff of Major Stream Groups," and by Table 5, which lists the estimated seasonal natural runoff of the American River from 1894-95 through 1950-51. Data contained in Table 5 are taken from State Water Resources Board Bulletin No. 1, "Water Resources of California." Plate 9 indicates the historical occurrence and duration of wet and dry runoff periods, and shows also the similarity between seasonal runoff ratios of major stream groups in the northern and southern parts of the region. The seasonal runoff of major streams has varied from about 20 per cent to more than 200 per cent of mean runoff.

The flow of minor streams, being directly dependent on the occurrence of precipitation, is likely to be flashy in nature, with wide fluctuations in discharge commonly occurring within short periods of time. The flow is not long sustained after the end of the rainy season. The bulk of the seasonal runoff of minor streams occurs during the four months from December through March, the flow during the summer months being very nearly zero in many years. Since minor streams have little or no snowshed area, there is no natural regulation of their runoff, and the flow during the season varies more or less directly with the occurrence of precipitation. The normal regimen of monthly flow of a minor stream is indicated on Plate 8, which also shows the characteristic difference in the normal regimens of major and minor streams. The runoff of minor streams also varies over a substantially greater range from season to season than that of major streams of the same latitudes. This condition is more pronounced in the southern part of the region where precipitation is less, particularly at the lower elevations, than in the northern section. In a dry year, precipitation on a minor stream watershed in the southern part of the region may be only slightly more than the use of water by native vegetation, so that runoff may be extremely small. Precipitation in the northern part of the region, however, is substantially higher than in the southern part, and a larger proportion of rainfall during dry years will produce runoff. For example, the seasonal runoff of the Chowchilla River has varied from 3 per cent to 334 per cent of the mean, while that of Butte Creek has ranged between 20 per cent and 199 per cent of the mean.

TABLE 5

ESTIMATED SEASONAL NATURAL RUNOFF OF AMERICAN RIVER AT FAIR OAKS

(In acre-feet)

Season	Estimated natural runoff at Fair Oaks	Season	Estimated natural runoff at Fair Oaks
1894-95	5,182,000	1924-25	2,717,000
95-96	3,564,000	25-26	1,386,000
96-97	3,064,000	26-27	3,652,000
97-98	938,000	27-28	2,521,000
98-99	1,854,000	28-29	1,147,000
1899-1900	3,297,000	1929-30	1,652,000
00-01	3,396,000	30-31	716,000
01-02	2,592,000	31-32	2,595,000
02-03	2,515,000	32-33	1,270,000
03-04	5,390,000	33-34	1,124,000
1904-05	2,174,000	1934-35	2,581,000
05-06	4,838,000	35-36	3,393,000
06-07	5,786,000	36-37	2,328,000
07-08	1,526,000	37-38	4,507,000
08-09	4,624,000	38-39	1,040,000
1909-10	3,614,000	1939-40	3,403,000
10-11	5,554,000	40-41	3,142,000
11-12	1,338,000	41-42	3,914,000
12-13	1,513,000	42-43	3,875,000
13-14	4,045,000	43-44	1,462,000
1914-15	3,154,000	1944-45	2,514,000
15-16	3,940,000	45-46	2,866,000
16-17	2,923,000	46-47	1,417,000
17-18	1,503,000	47-48	2,239,000
18-19	2,229,000	48-49	1,857,000
1919-20	1,467,000	1949-50	2,664,000
20-21	3,204,000	50-51	4,549,000
21-22	3,279,000		
22-23	2,751,000		
23-24	543,000		

Mean seasonal natural runoff for 53-year mean period, 1894-95 through 1946-47: 2,774,000

Quantity of Runoff

The Mother Lode Region is one of the great water-producing areas of California. The aggregate mean seasonal natural runoff of the seven major rivers and the numerous minor streams tributary to the region is estimated to be almost 17,000,000 acre-feet. This water supply is about one-half of that of the entire Central Valley, and is almost one-fourth of the total runoff of the entire State. The water productivity of the Mother Lode Region as a whole is indicated by the fact that the gross drainage area of its tributary streams is less than one-fourth of that of the Central

Valley and less than one-tenth of that of the whole State.

If the surface runoff of the Mother Lode Region were evenly distributed on a geographical basis, problems of water supply development would be greatly simplified. This desirable condition, however, does not exist, for the northern half of the region, that is, the area north of the Cosumnes River watershed, produces almost two-thirds of the total runoff of the entire region.

The estimated natural runoff of major streams and principal minor streams tributary to the region is listed in Table 6 for mean, maximum, and minimum seasons. The table also indicates the average runoff during the driest period of record, which extended from 1929 through 1934. Minor streams with mean seasonal runoff of less than 30,000 acre-feet are omitted from the table.

QUALITY OF WATER

In order to determine the mineral quality of the waters of the Mother Lode Region, water samples were obtained from several different points on all of the major streams, and from at least one point on the principal minor streams. All of the samples were analyzed for their mineral constituents. The surface water supplies of the region are of excellent mineral quality and are well suited for irrigation and other beneficial uses.

Terms commonly used in discussions of water quality are defined as follows:

Quality of Water—Those characteristics of water affecting its suitability for beneficial uses.

Mineral Analysis—The quantitative determination of inorganic impurities or dissolved mineral constituents in water.

Degradation—Impairment in the quality of water due to causes other than disposal of sewage and industrial wastes.

Contamination—Impairment of the quality of water by sewage or industrial waste to a degree which creates a hazard to public health through poisoning or spread of disease.

Pollution—Impairment of the quality of water by sewage or industrial waste to a degree which does not create a hazard to public health, but which adversely and unreasonably affects such water for beneficial uses.

Hardness—A characteristic of water which causes curdling of soap, increased consumption of soap, deposition of scale in boilers, injurious effects in some industrial processes, and sometimes objec-

TABLE 6

ESTIMATED NATURAL RUNOFF OF PRINCIPAL STREAMS, MOTHER LODE REGION

Stream and station	Drainage area, in square miles	Seasonal runoff, in acre-feet			
		53-year mean, 1894-95 through 1946-47	Maximum	Minimum	Average during critical period, 1929 through 1934
Sacramento River Tributaries					
American River at Fair Oaks	1,921	2,774,000	5,786,000	543,000	1,417,000
Bear River near Wheatland	295	356,000	841,000	64,000	149,000
Butte Creek near Chico	148	272,500	595,000	55,000	126,000
Chico Creek near Chico	68	116,000	252,000	23,400	48,700
Coon Creek at Highway 99E	84	30,600	90,400	5,500	12,800
Dry Creek near Waldo	69	34,000	80,000	6,000	14,300
Feather River near Oroville	3,611	4,596,000	9,504,000	1,317,000	2,464,000
French Dry Creek at Virginia Ranch	72	79,200	187,000	14,000	33,000
South Honcut Creek at La Porte Road	69	41,400	98,000	7,400	17,300
Yuba River at Smartville	1,194	2,415,000	4,544,000	603,000	1,289,000
Subtotals	7,529	10,714,700	21,959,000	2,638,300	5,571,100
San Joaquin River Tributaries					
Bear Creek near Planada	164	36,100	121,000	1,200	12,500
Calaveras River at Jenny Lind	395	199,000	708,000	13,400	58,000
Chowchilla River at Buchanan dam site	238	91,300	305,000	3,000	31,500
Cosumnes River at Michigan Bar	537	374,000	876,000	40,400	146,000
Dry Creek near Cooperstown	145	30,400	108,000	2,000	8,900
Dry Creek near Ione	279	98,900	288,000	7,700	31,700
Littlejohns Creek near Farmington	213	47,000	137,000	6,500	18,700
Merced River at Exchequer	1,035	1,027,000	2,378,000	252,000	542,000
Mokelumne River near Clements	630	780,000	1,737,000	187,000	416,000
Stanislaus River near Knights Ferry	983	1,210,000	2,811,000	261,000	663,000
Tuolumne River near La Grange	1,540	1,900,000	3,747,000	552,000	1,129,000
Subtotals	6,159	5,793,700	13,216,000	1,326,200	3,057,300
TOTALS	13,688	16,508,400	35,175,000	3,964,500	8,628,400

tionable taste, and which is due in large part to the presence of salts of calcium, iron, and magnesium.

Complete mineral analysis included a determination of three cations, consisting of calcium, magnesium, and sodium; four anions, consisting of bicarbonate, chloride, sulphate, and nitrate; total soluble salts; boron; per cent sodium; and degree of hardness.

With the exception of boron, the concentrations of cations and anions in a water sample are expressed in this bulletin in terms of "equivalents per million." This was done because ions combine with each other on an equivalent basis, rather than on the basis of weight, and a chemical equivalent unit of measurement provides a better and more convenient expression of concentration. This is especially true when it is desired to compare the composition of waters having variable concentrations of mineral solubles. In the case of boron, concentrations are expressed on a weight basis of "parts per million" of water. In order to convert equivalents per million to parts per million, the concentration, expressed in equivalents per million, should be multiplied by the equivalent weight of the cation or the anion in question. Equivalent weights of the common cations and anions are presented in the following tabulation:

Cation	*Equivalent weight*	*Anion*	*Equivalent weight*
Calcium (Ca)	20.0	Bicarbonate (HCO_3)	61.0
Magnesium (Mg)	12.2	Chloride (Cl)	35.5
Sodium (Na)	23.0	Sulphate (SO_4)	48.0
		Nitrate (NO_3)	62.0

Data used to determine the quality of water in the region consisted of complete mineral analyses of 46 surface water samples taken during September and October, 1952, and in January, 1953.

Standards of Quality for Water

Investigation and study of the quality of surface and ground waters of the Mother Lode Region, as reported herein, were largely limited to consideration of mineral constituents of the waters, with particular reference to their suitability for irrigation use. However, it may be noted that, within the limits of the mineral analyses herein reported, a water which is determined to be suitable for irrigation may also be considered as being either generally suitable for municipal and domestic use, or susceptible to such treatment as will render it suitable for that purpose.

The major criteria which were used as a guide to judgment in determining suitability of water for irrigation use comprised the following: (1) chloride concentration, (2) total soluble salts, (3) boron concentration, and (4) per cent sodium.

1. The chloride anion is usually the most troublesome element in most irrigation waters. It is not considered essential to plant growth, and excessive concentrations will inhibit growth.

2. Total soluble salts furnish an approximate indication of the over-all mineral quality of water, and may be approximated by multiplying specific electrical conductance (EC x 10^6 at 25° C.) by 0.7. The presence of excessive amounts of dissolved salts in irrigation water will result in reduced crop yields.

3. Crops are sensitive to boron concentration, but require a small amount (less than 0.1 part per million) for growth. They will usually not tolerate more than 0.5 to 2 parts per million, depending on the crop in question.

4. Per cent sodium reported in the analyses is the proportion of the sodium cation to the sum of all cations, and is obtained by dividing sodium by the sum of calcium, magnesium, and sodium, all expressed in equivalents per million, and multiplying by 100. Water containing a high per cent sodium has an adverse effect upon the physical structure of the soil by dispersing the soil colloids and making the soil "tight", thus retarding movement of water through the soil, retarding the leaching of salts, and making the soil difficult to work.

The following excerpts from a paper by Dr. L. D. Doneen, of the Division of Irrigation of the University of California at Davis, may assist in interpreting water analyses from the standpoint of their suitability for irrigation:

"Because of diverse climatological conditions, crops, and soils in California, it has not been possible to establish rigid limits for all conditions involved. Instead, irrigation waters are divided into three broad classes based upon work done at the University of California, and at the Rubidoux, and Regional Salinity laboratories of the U. S. Department of Agriculture.

"Class 1. *Excellent to Good*—Regarded as safe and suitable for most plants under any condition of soil or climate.

"Class 2. *Good to Injurious*—Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

"Class 3. *Injurious to Unsatisfactory*—Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

"Tentative standards for irrigation waters have taken into account four factors or constituents, as listed below.

Factor	*Class 1 excellent to good*	*Class 2 good to injurious*	*Class 3 injurious to unsatisfactory*
Conductance (EC x 10^6 at 25° C.)	Less than 1000	1000-3000	More than 3000
Boron, ppm	Less than 0.5	0.5-2.0	More than 2.0
Per cent sodium	Less than 60	60-75	More than 75
Chloride, epm	Less than 5	5-10	More than 10

(End of quotation)

Hardness of water is caused principally by compounds of calcium and magnesium, although other mineral constituents such as iron, manganese, aluminum, barium, silica, and strontium, may contribute to the hardness. In this bulletin, total hardness is expressed in parts per million in terms of calcium carbonate hardness. It was computed by adding calcium and magnesium, expressed in equivalents per million, and multiplying this sum by 50. Water having a total hardness of less than 50 parts per million is rated as soft water for nearly all purposes except the most exacting of industrial uses, and seldom requires treatment for reduction or elimination of hardness. Water having a range of total hardness from 50 to 150 parts per million is suitable for most household uses. However, in the case of such water, reduction of hardness by softening processes would reduce soap consumption and deposits of scale in plumbing systems, thus enhancing the suitability of the water for laundries and other industrial purposes. Where total hardness in water exceeds from 150 to 200 parts per million, water softening processes are usually resorted to in order to render the water more acceptable for domestic, municipal, and industrial uses. However, objections to hardness in water may depend on local opinion, and a water considered too hard in certain localities might be considered satisfactory in others.

Quality of Surface Water

Analysis of the 46 surface water samples collected in September and October of 1952, and in January of 1953, showed that, at those times, the waters of all the stream sampled were of excellent mineral quality and were well suited for irrigation use and for other beneficial uses. All of the waters sampled were characterized by very low contents of total mineral solubles, chloride, and boron, and by low per cent sodium. The range in the values of the factors affecting the suitability of water for irrigation use, as determined by the complete analyses of the samples, is listed in the following tabulation. It is noted that the analyses indicated a Class 1 rating for all of the samples.

Factor	*Range*
Conductance, EC $\times 10^6$ at 25° C.	14-301
Boron, ppm	0-0.12
Sodium, per cent	7-47
Chloride, epm	0.01-0.34

From a standpoint of hardness, the waters of the region were of excellent quality at the times of sampling. This is indicated in the following tabulation, which shows the number of samples arranged according to the established scale of hardness. It is noted that 34 of the 46 samples are rated as soft, and that the remaining 12 samples are rated as suitable for most household uses without special treatment. Of the latter group, only two samples showed a hardness rating exceeding 100.

Number of samples	*Hardness rating*	*Rating*
34	Less than 50	Soft
12	50 to 150	Suitable for most household uses without treatment
0	Over 150	Hard, treatment usually required

Of the twelve samples with hardness ratings between 50 and 150, three were taken from the North Fork of Yuba River, two from the Middle Fork of Feather River, and one each from Middle Fork of Yuba River, Chico Creek, French Dry Creek, Calaveras River, Littlejohns Creek, Dry Creek in Amador County, and Dry Creek in Stanislaus County. With the exception of those taken from the latter two streams, all of the samples were taken during the first week of October, 1952, when stream flow was at low stages. Dry Creek in Amador County and Dry Creek in Stanislaus County were sampled in January, 1953. The flow in the two streams at that time was at fairly high stages. Only two of the twelve samples showed hardness ratings exceeding 100. These two samples were taken from Dry Creek in Amador County and from the Calaveras River.

Complete analyses of the 46 water samples taken from streams of the Mother Lode Region are presented in Appendix C.

CHAPTER III

WATER UTILIZATION AND REQUIREMENTS

This chapter considers the nature and extent of (1) present and ultimate consumptive use of applied water, (2) factors of water demand, and (3) ultimate water requirements. In connection with the discussion, the following terms are used as defined.

Water Utilization—This term is used in a broad sense to include all employments of water by nature or man, whether consumptive or nonconsumptive, as well as those irrecoverable losses of water incidental to such employment, and is synonymous with the term "water use."

Factors of Water Demand—Those factors pertaining to specific rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of the water for beneficial purposes.

Water Requirement—The water needed to provide for any beneficial consumptive use, and those irrecoverable losses incidental to such use.

Consumptive Use of Water—The quantity of water consumed by vegetative growth in transpiration and the building of plant tissue, and to water evaporated from soil adjacent to the plant, from water surfaces, and from foliage. Consumptive use is the total quantity of water, regardless of source, which is consumed by these processes. A part of consumptive use may be satisfied by rainfall, a part by soil moisture carried over from winter rains and consumed during the growing season, and a part may be satisfied by water applied from canal diversions or by pumping from ground water. Consumptive use also refers to water similarly consumed by urban areas and by other nonvegetative types of use.

Applied Water—The quantity of water which is delivered to a farmer's headgate in the case of irrigation use, or to an individual's meter in the case of urban use, or the equivalent. It does not include direct precipitation.

Ultimate—This term refers to an unspecified date in the distant future when development will be essentially stabilized, that is, when maximum development has been achieved. Under this condition maximum utilization of water will have been reached.

Stream Depletion—The extent to which the natural flow of a given stream is reduced by the development and utilization of water from the stream.

The studies and investigations undertaken in connection with this bulletin were designed to determine, so far as possible, present and ultimate land use patterns, unit consumptive water use factors for irrigation and other purposes, present and ultimate consumptive use of water, and ultimate water requirements measured in terms of consumptive use of applied water plus irrecoverable losses. In addition, there is included in this chapter a discussion of the factors of water demand, with emphasis given to their effect on stream depletion and on water requirements. Present and probable ultimate land use patterns were defined on the basis of a detailed survey of all of the irrigable lands, and on the basis of an analysis of crop adaptability with respect to soils, topography, and climate. Consumptive use factors for crops grown in the region were computed for each service area on the basis of an evaluation and analysis of the climatic factors affecting crop growth and water use. Estimates of present and ultimate consumptive use of water were evaluated by applying consumptive use factors to land use patterns.

PRESENT WATER SUPPLY DEVELOPMENT

The history of water utilization in the Mother Lode Region during the 80 years between the peak of the mining boom and the beginning of World War II can be described as one of little development. Although reliable data concerning water utilization during the early days of the region are not available, it may be assumed, on the basis of population figures and on the knowledge that irrigated agriculture flourished during the great mining era, that the total use of water for consumptive purposes then was essentially of the same order of magnitude as it is today. In specific localities, such as the Auburn district of Placer County, water utilization today is undoubtedly much larger than it was during the mining era of the last century. Considering the region as a whole, however, there is no evidence to indicate that water use for consumptive purposes has increased substantially since the days of the mining boom.

Since World War II, demands for water in the region have been sharply accelerated. Evidence of increasing requirements for water is manifested by the formation since World War II of a number of public agencies charged with the development and distribution of water supplies for irrigation and other uses within the region. These agencies, and all of the older public water supply agencies concerned with irrigation, are planning new projects designed to satisfy increasing requirements for water. Until some of these

Melones Reservoir, Calaveras and Tuolumne Counties

Courtesy of Tuolumne County Chamber of Commerce proposed projects are completed, no substantial increase in water utilization can be accomplished.

Today, the total use of water in the Mother Lode Region is estimated to be no more than 10 per cent of that which would occur under conditions of maximum development. More than 80 per cent of the total quantity of water consumed within the region is used for irrigation purposes. On the basis of studies made for this bulletin, it is considered probable that the present predominance of irrigation water use over all other uses will prevail in the future, possibly to an even greater degree.

Virtually all of the water consumed in the Mother Lode Region is obtained from surface water supplies. Small quantities of ground water are pumped for domestic and stockwatering purposes, and in a few areas of very limited extent some ground water is used for irrigation. Most of the irrigated lands which are supplied wholly or partially from ground water are located along the Cosumnes River in Sacramento County and along the Mokelumne River in San Joaquin County. Both of these areas are on the fringes of the large ground water basins of the Central Valley. On the basis of available records of diversions and deliveries of water, and of land use data obtained by field surveys conducted for the investigation, it is estimated that, of the total quantity of water consumed within the Mother Lode Region, about 50 per cent is distributed by major public water service agencies, about 25 per cent by the Pacific Gas and Electric Company, and the remaining 25 per cent by public and private agencies of minor size and by individual consumers who have developed their own water supplies.

In the Mother Lode Region today there are nine public water service agencies of major size which are

TABLE 7

PRINCIPAL WATER SERVICE AGENCIES, MOTHER LODE REGION

Name of agency	Location	Gross area, in acres	Year organized	Principal source of water supply	Principal reservoir storage facilities: Name	Stream	Gross capacity, in acre-feet	Acreage irrigated in 1951
Paradise Irrigation District	Butte County	11,250	1916	Little Butte Creek	Magalia	Little Butte Creek	3,540	[a]4,000
Oroville-Wyandotte Irrigation District	Butte County	24,300	1919	South Fork Feather River	Lost Creek	Lost Creek	5,200	4,500
Browns Valley Irrigation District	Yuba County	42,000	1888	North Fork Yuba River		None		3,300
Nevada Irrigation District	Nevada and Placer Counties	268,000	1921	Middle and South Forks Yuba River, and Bear River	Bowman Scotts Flat French Lake Combie	Canyon Creek Deer Creek Canyon Creek Bear River	68,000 26,300 12,500 9,000	[b]16,920
Georgetown Divide Public Utility District	El Dorado County	65,000	1946	Rubicon River	Loon Lake	Gerle Creek	8,000	1,600
El Dorado Irrigation District	El Dorado County	32,600	1925	South Fork American River	Webber Creek	Webber Creek	1,275	5,700
Yuba County Water District [c]	Yuba County	112,500	1952			None		None
Pacific Gas and Electric Company	Placer County			South Fork Yuba River	Spaulding Fordyce Lake Valley	South Fork Yuba River North Fork American River	74,500 46,600 8,100	16,000
Calaveras County Water District [c]	Calaveras County	665,000	1946			None		None
Tuolumne County Water District No. 2 [c]	Tuolumne County	815,000	1947			None		None
Pacific Gas and Electric Company	Amador County			North Fork Mokelumne River	Salt Springs	North Fork Mokelumne River	139,400	30
Pacific Gas and Electric Company	Calaveras County			North Fork Stanislaus River	Spicers, Union, Utica, Silver Valley	North Fork Stanislaus River	12,800	800
Pacific Gas and Electric Company	Tuolumne County			South Fork Stanislaus River	Strawberry Lyons	South Fork Stanislaus River	18,600 5,500	1,400

[a] The Paradise Irrigation District has developed into a semi-urban area, containing many small homesite tracts of an acre or less in area. It is estimated that less than half the 4,000 acres shown as irrigated could be described as agricultural in the usual sense.
[b] Nevada Irrigation District also furnished water to about 2,900 acres of rice lands in Sutter County.
[c] District is recently organized, and has not yet achieved operational status.

now, or will be, concerned with the development and distribution of irrigation water as well as municipal and domestic water. Four of these agencies have been established since World War II, and one of the four has already acquired a water storage and distribution system and is now in active operation. The other three agencies have not achieved operational status as yet, but they are actively engaged with matters of organization, water rights, and plans. All of the major public water service agencies which are now providing substantial quantities of water for irrigation use are located in the northern half of the region.

The Pacific Gas and Electric Company operates extensive hydroelectric systems on the Feather, Yuba, Bear, American, Mokelumne, and Stanislaus Rivers. In the course of developing these hydroelectric systems the company and its predecessors acquired many of the old ditches and reservoirs which were built during the great era of hydraulic mining in California. Since water rights were attached to these ditch systems, the company incurred obligations to furnish water to areas dependent on the ditch systems for domestic, municipal, and irrigation supplies. In light of these obligations, and under contracts executed subsequently, the Pacific Gas and Electric Company sells water to small public and private water service agencies, to local associations of water users, and to individual consumers in Tuolumne, Calaveras, Amador, and Placer Counties. The company also sells water to the El Dorado Irrigation District, a major public water service agency in El Dorado County. These sales of water represent only a minor part of the total controlled water supply developed by the company's reservoirs. Most of the water supply so developed flows through the company's power plants, and incidentally provides indirect but substantial benefits in the form of regulated flows to downstream diverters both inside and out of the Mother Lode Region.

Principal water service agencies in the Mother Lode Region, both public and private, are listed in Table 7, together with pertinent data regarding sources of water supply, project works, and acreages irrigated in 1951. In the case of irrigation districts, the figures for irrigated acreages are taken from data furnished the Division of Water Resources by the districts themselves. The extent of irrigated areas which obtain water from the Pacific Gas and Electric Company was estimated on the basis of the land use survey conducted for this investigation in 1949, 1950, and 1951, as were figures for the area served by the Georgetown Divide Public Utility District. Boundaries of the public agencies listed in Table 7 are shown on Plate 2.

The Pacific Gas and Electric Company has no definite water service area boundaries, and its service areas in Calaveras and Tuolumne Counties are within the boundaries of recently organized major public water service agencies. For these reasons no attempt was made to delineate water service areas of the Pacific Gas and Electric Company on Plate 2. For purposes of this bulletin, however, the Mother Lode Region was divided arbitrarily into water service areas based on sources of water supply and on topographic and land use factors controlling the location of possible water distribution systems. These service areas are delineated on Plate 2. The areas which are now receiving the bulk of their present water supplies directly from the Pacific Gas and Electric Company may be identified on Plate 2 as follows:

County	*Service area*
Amador	Jackson
Calaveras	Stanislaus
Placer	Colfax and Loomis
Tuolumne	Lyons and Phoenix

The reservoirs listed in Table 7 do not constitute a measure of the present development of water resources to meet consumptive requirements within the Mother Lode Region because the Pacific Gas and Electric Company reservoirs are operated primarily for hydroelectric purposes. Nevertheless, any reservoir so operated will also produce indirectly a dependable water supply for irrigation and municipal uses. In general, the dependable irrigation yield of a reservoir operated for hydroelectric purposes will be about half the firm yield of water developed for power purposes. In the case of Lake Spaulding and Lake Fordyce on the South Fork of Yuba River, the bulk of the water released during the irrigation season is utilized for irrigation and municipal purposes within the Mother Lode Region, and the flow of stored water from these reservoirs to the Central Valley is small during the irrigation season. Lake Spaulding and Lake Fordyce are properly considered, therefore, as about 50 per cent effective as water conservation projects serving lands in the Mother Lode Region. The situation on the Mokelumne River, however, is not the same. Diversions from that stream to Amador County are very small in relation to the total release of water from Salt Springs Reservoir. This reservoir therefore cannot be considered as a conservation project serving lands in the Mother Lode Region. The irrigation and municipal water supply benefits of Salt Springs Reservoir accrue to areas outside the Mother Lode Region. A similar situation exists in the case of Strawberry Reservoir on the South Fork of Stanislaus River.

It is estimated that about 75 per cent of the total quantity of water consumptively utilized in the Mother Lode Region is distributed by the agencies described in Table 7. The remaining 25 per cent is developed by public and private agencies of minor size and by individuals. The water supplies developed by these agencies and individuals do not involve the use of reservoirs or other project works of more than

Moccasin Creek Power House, Tuolumne County

Courtesy of Tuolumne County Chamber of Commerce nominal capacity. The largest water supply development not included in Table 7 is that of the Calaveras Public Utility District, which furnishes municipal water supplies to the towns of Mokelumne Hill and San Andreas in Calaveras County. The district operates a reservoir of 1,700 acre-foot storage capacity on the Middle Fork of Mokelumne River, and another of 775 acre-foot capacity on the North Fork of Calaveras River. This agency is not concerned with irrigation at present, and it appears that the Calaveras County Water District, which embraces the entire area of the county, will become the agency concerned with any large-scale development of irrigation and municipal water supplies in Calaveras County.

The reservoirs listed in Table 7, with major limitations applying to those of the Pacific Gas and Electric Company, can be considered to represent virtually the entire water supply development serving lands within the Mother Lode Region today. The situation is one of little development everywhere in the region except in the Yuba River Basin. Moreover, it is pointed out that no substantial increase in use of water can be accomplished anywhere in the region unless new water conservation projects are undertaken. Although all of the public agencies listed in Table 7 are planning new projects, the only one of these which has reached construction stages is the Sly Park Project on the Cosumnes River. This project, under construction by the United States Bureau of Reclamation, will provide about 20,000 acre-feet of new water seasonally to the El Dorado Irrigation District in El Dorado County.

Present development of the water resources of the Mother Lode Region is meager so far as service to lands within the region itself is concerned, but water supply developments serving areas outside the region are substantial. These developments serve large areas of rich and highly developed agricultural lands on the east side of the Central Valley, as well as the large metropolitan regions of the San Francisco Bay Area. The development of dependable water supplies for the benefit of these outside areas has advanced to a much higher degree in the southern part of the region, where major conservation reservoirs exist for this purpose on all of the four major streams. Moreover, definite plans for substantial enlargement of all of these water supply systems, with the exception of that on the Merced River, have progressed to the point that construction is already under way on the Tuolumne River, and is imminent on the Stanislaus River.

In the northern part of the Mother Lode Region a different situation exists. Although streams in this area are sources of supply for valley floor lands outside of the region, there is no conservation project of substantial size which exists for that purpose. Most of the water so utilized is obtained by direct diversion of stream flow as regulated by hydroelectric systems of the Pacific Gas and Electric Company and by conservation projects serving lands within the Mother Lode Region. Thus, the development and use of the water resources of the northern part of the region for the benefit of outside areas does not approach that already accomplished in the southern part of the region. This is the situation now. New projects, however, will alter the situation in the future. The Folsom Project on the American River is nearing completion by the United States Corps of Engineers, and the Oroville Project on the Feather River, authorized for construction by the State of California, has reached advanced planning stages. The water supplies produced by these projects cannot be delivered by gravity flow to lands in the Mother Lode Region, although limited areas could be served by pumping from project main canals.

The present development of the water resources of the Mother Lode Region is shown on Plate 10, entitled "Existing Water Conservation Works, 1951." The plate indicates the location of existing reservoirs, power houses, and principal conveyance systems. Projects under construction are also shown on the plate. Detailed information concerning location, capacity, and ownership of the various project features is presented in Appendix D. Reservoirs storing less than 5,000 acre-feet of water are omitted from the plate, unless they have special significance.

The present development of the water resources of the Mother Lode Region for the benefit of areas outside the region is summarized in Table 8. The table identifies water service agencies and service areas, and presents data concerning sources of water supply project works, acreages irrigated, and gross diversions in 1951. In most cases, data concerning irrigated acreages and gross diversions were taken from the annual report of the Sacramento-San Joaquin Water Supervision, published by the Division of Water Resources. Similar data concerning the Table Mountain, Thermalito, and Camp Far West Irrigation Districts were taken from information furnished the Division of Water Resources each year by these districts. Figures for gross diversions of the East Bay Municipal Utility District, and for the City and County of San Francisco were taken from records compiled by those agencies. In addition to the major diversion shown in Table 8, there are numerous diversions of minor significance on all of the streams. In many cases, these minor diversions are satisfied by return flow from the larger diversions, and do not represent any significant depletion of the stream.

The information presented in Table 8, so far as it applies to major streams, is summarized on Plate 11, entitled "Comparison of 1951 Diversions From the Mother Lode Region by Major Water Service Agencies Outside the Region." The plate indicates that the development of major streams for the benefit of

TABLE 8

MAJOR WATER SERVICE AGENCIES DIVERTING WATER FROM STREAMS OF THE MOTHER LODE REGION FOR UTILIZATION IN AREAS OUTSIDE THE REGION

Stream basin and water service agency	Service area	Major conservation reservoirs	Stream	Gross reservoir storage capacity, in acre-feet	Acreage irrigated in 1951	Gross diversion in 1951, in acre-feet
Feather River						
Thermalito and Table Mountain Irrigation Districts	Butte County	Concow	Concow Creek	8,600	2,120	12,940
Western Canal Company		None; direct diversion	Feather River		23,524	113,929
Richvale Irrigation District	Butte County	None; direct diversion	Feather River		14,027	142,687
Biggs-West Gridley Water District	Butte County	None; direct diversion	Feather River		11,838	119,915
Sutter-Butte Canal Company	Butte and Sutter Counties	None; direct diversion	Feather River		16,997	141,081
Sutter Extension Water District	Sutter County	Nooe; direct diversion	Feather River		10,682	106,133
Subtotals					79,188	696,685
Yuba River						
Cordua Irrigation District	Yuba County	None; direct diversion	Yuba River		6,224	47,179
Hallwood Irrigation District	Yuba County	None; direct diversion	Yuba River		6,438	71,426
Subtotals					12,662	118,605
Bear River						
Camp Far West Irrigation District	Yuba and Placer Counties	Camp Far West	Bear River	5,000	2,085	[a]8,000
American River						
Carmichael Irrigation District	Sacramento County	None; direct diversion	American River		3,800	[b]3,438
North Fork Ditch Company	Sacramento County	None; direct diversion	North Fork		Not available [c]	[a]28,000
Subtotals					3,800	31,438
Cosumnes River						
No major diversions						
Mokelumne River						
East Bay Municipal Utility District	Oakland and vicinity	Pardee	Mokelumne River	210,000	None	90,481
Woodbridge Irrigation District	San Joaquin County	None; direct diversion	Mokelumne River		16,069	117,150
Subtotals					16,069	207,631
Calaveras River						
No major diversion						
Stanislaus River						
Oakdale Irrigation District	Stanislaus and San Joaquin Counties	Melones [d]	Stanislaus River	112,500	54,858	210,400
South San Joaquio Irrigation District	San Joaquin County	Woodward	Simmons Creek	35,000	63,652	226,909
Subtotals					118,510	437,309
Tuolumne River						
Modesto Irrigation District	Stanislaus County	Don Pedro [e]	Tuolumne River Tributary	289,000	70,531	305,299
		Dallas; Warner	Tuolumne River Tributary	27,000		
		Owens	Tuolumne River	49,000	163,725	568,026
Turlock Irrigation District	Stanislaus and Merced Counties					
Waterford Irrigation District	Stanislaus County	None; water furnished by Modesto Irrigation District			6,700	41,615
City and County of San Francisco	San Francisco metropolitan area	Hetch Hetchy	Tuolumne	360,000	None	81,451
		Lake Eleanor	Eleanor Creek	27,800		
Subtotals					240,956	996,391
Merced River						
Merced Irrigation District	Merced County	Exchequer	Merced River	289,000	112,952	532,620
TOTALS					586,222	3,028,679

[a] Estimated.
[b] Partial water supply obtained from wells. Area is semi-suburban in character.
[c] Company furnished water to the Fair Oaks and Citrus Heights Irrigation Districts and to the Orangevale Mutual Water Company, the service areas of which include large areas of suburban development and rural nonfarm development. Reliable data regarding gross diversions and irrigated acreage are not available.
[d] Melones Reservoir is jointly owned by the Oakdale and South San Joaquin Irrigation Districts.
[e] Don Pedro Reservoir is jointly owned by the Modesto and Turlock Irrigation Districts.

areas outside the Mother Lode Region has advanced to a much higher degree in the southern part of the region than in the northern part. It is apparent, therefore, that the development of new water supplies from the unappropriated waters of the Mokelumne, Stanislaus, Tuolumne, and Merced Rivers will be considerably more difficult than on the Feather, Yuba, and American Rivers. However, developments such as the Feather River Project could alleviate this situation by providing alternative sources of water supply for downstream areas which are now using water from local Sierra Nevada streams. This exchange of water supply would be possible, and the mountain and foothill areas would thereby become direct beneficiaries of the projects. Such a solution may not always be feasible or necessary. It should be emphasized, however, that the mountain areas have no feasible source of water supply other than the local Sierra Nevada streams in their vicinity.

LAND USE

One of the fundamental questions which any comprehensive water resources investigation must answer is: What is the extent of present and ultimate water requirements? The answer depends on the purposes for which the area is developed and on the extent of the development, or, in other words, the answer depends on the land use. Water requirements can be evaluated where land use is established. From the standpoint of water utilization, the primary types of land use are agricultural and urban. Lands which do not fall into one of these catgories are referred to as "Unclassified Areas" for present conditions of development and as "Other Water Service Areas" for ultimate conditions of development. In this bulletin, all lands in the Mother Lode Region are segregated according to these categories of land use, and the water requirement of each group is considered separately.

Estimates of the requirement of irrigated areas for water were based primarily on a field survey conducted by the Division of Water Resources to measure the present use of the irrigable lands in the Mother Lode Region and to determine the location and extent of all lands suitable for agricultural use, whether developed or not. The survey, which was carried out in the field from 1947 to 1950, covered the entire Mother Lode Region lying west of the national forests, a total area of about 6,000 square miles. The choice of the national forest boundaries as the upper limit of the land use and land classification survey was based on the assumption that no integrated agricultural economy could be established within the national forests because of the severity of the winter climate, the short growing season, the mountainous nature of the terrain, and also because the term "national forests" implies the maintenance of timber resources and recreational values. In every case where contiguous areas of irrigable land extended into the national forests, however, those areas were included in the survey.

For purposes of identification, that part of the Mother Lode Region covered by the land use and land classification survey is referred to as the "agricultural zone." The remainder of the region is referred to as the "national forest zone." Data regarding present and ultimate irrigated areas in the national forest zone were obtained from the United States Forest Service.

In the land use and land classification survey, no effort was made to delineate urban areas, either present or potential. The extent of urban areas is not significant at present, and no realistic basis exists for estimating the location of future urban areas. For this bulletin, the areal extent, but not the location, of present and probable ultimate urban areas was derived on the basis of population figures and estimates.

In studying ultimate land use and total ultimate water requirements, all lands within the boundaries of the region were considered. In estimating ultimate water requirements, therefore, allowances were made for every acre of land within the boundaries of the Mother Lode Region.

Present Land Use Pattern

The present land use pattern in the Mother Lode Region is discussed separately in this section for present use of irrigable lands in the agricultural zone, irrigated and irrigable areas in the national forest zone, and present urban areas. These discussions are summarized at the end of the section.

Present Use of Irrigable Lands in the Agricultural Zone. The results of the land use survey were considered to represent "present" use of the irrigable lands in the agricultural zone of the Mother Lode Region. The survey segregated the irrigable lands into cultivated and noncultivated areas, and the cultivated areas were further classified as irrigated or nonirrigated. Areas occupied by individual crops were segregated for both irrigated and dry-farmed lands. Irrigable lands not under cultivation were classified as dry pasture, woodland pasture, or as unused or idle lands, although these classifications are not definitive to the same degree as those which apply to the cultivated areas.

The land use survey was conducted concurrently with the land classification survey, and both possess the same accuracy. The survey may be described as a detailed reconnaissance. Irrigable lands were mapped in the field on aerial photographs scaled at about three inches to the mile. At this scale, the minimum area which could be separated and mapped was about five acres. For this reason, nonirrigable

TABLE 9

PRESENT USE OF IRRIGABLE LANDS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

(Gross areas, in acres)

County and service area	Cultivated																Non-cultivated	Gross irrigable area
	Irrigated									Nonirrigated								
	Pasture	Deciduous orchard	Grain hay	Vines	Truck	Alfalfa	Citrus	Field crops	Total	Grain hay	Deciduous orchard	Vines	Truck	Alfalfa	Citrus	Total		
Amador																		
Ione	380	40	240	10	60	100	0	0	830	4,560	70	10	0	0	0	4,640	32,560	38,030
Jackson	0	0	0	0	0	0	0	0	0	300	210	250	0	0	0	760	9,830	10,590
Plymouth	40	0	0	0	0	0	0	0	40	810	350	550	0	0	0	1,710	8,110	9,860
Volcano	30	0	0	0	0	0	0	0	30	130	130	50	0	0	0	310	8,900	9,240
Subtotals	450	40	240	10	60	100	0	0	900	5,800	760	860	0	0	0	7,420	59,400	67,720
Butte																		
Bidwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,170	5,170
Big Bend	30	10	0	0	0	0	0	0	40	80	20	0	0	0	0	100	3,960	4,100
Buckeye	230	30	0	0	0	0	0	0	260	40	10	0	0	0	0	50	4,870	5,180
Chico	0	20	0	0	0	0	0	0	20	100	110	10	0	0	0	220	3,450	3,690
Deer Creek	0	0	0	0	0	0	0	0	0	0	120	0	0	0	0	120	4,660	4,780
Magalia	120	1,650	0	60	40	40	0	0	1,870	570	560	30	0	0	0	1,160	16,320	19,350
Wyandotte	400	2,800	200	0	0	0	590	0	3,990	680	350	40	0	0	240	1,310	28,730	34,030
Subtotals	780	4,510	200	60	40	40	590	0	6,180	1,470	1,170	80	0	0	240	2,960	67,160	76,300
Calaveras																		
Bear Mountain	0	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0	1,000	20,300	21,300
Calaveras	180	40	10	0	0	0	0	0	230	510	200	10	0	0	0	720	15,760	16,710
Hogan	10	220	50	0	80	0	0	0	360	1,570	540	280	0	0	0	2,390	19,450	22,200
Mokelumne	240	10	0	0	0	0	0	0	250	320	90	40	0	0	0	450	15,380	16,080
Rock Creek [a]	0	0	0	0	0	0	0	0	0	120	30	0	0	0	0	150	5,820	5,970
Stanislaus	690	110	10	0	0	0	0	0	810	820	130	40	0	0	0	990	11,550	13,350
West Point	90	10	0	0	0	0	0	0	100	10	220	0	0	0	0	230	2,810	3,140
Subtotals	1,210	390	70	0	80	0	0	0	1,750	4,350	1,210	370	0	0	0	5,930	91,070	98,750
El Dorado																		
Aukum	0	0	0	0	0	0	0	0	0	0	130	20	0	0	0	150	10,300	10,450
Georgetown	940	640	0	0	0	0	0	0	1,580	280	460	0	0	0	0	740	13,270	15,590
Latrobe	0	0	0	0	0	0	0	0	0	200	0	0	0	0	0	200	6,360	6,560
Placerville	210	5,820	0	20	0	0	0	0	6,050	1,640	750	150	0	0	0	2,540	43,310	50,900
Youngs	0	0	0	0	0	0	0	0	0	50	100	0	0	0	0	150	7,250	7,400
Subtotals	1,150	6,460	0	20	0	0	0	0	7,630	2,170	1,440	170	0	0	0	3,780	79,490	90,900
Mariposa																		
Baxter [b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,400	4,400
Chowchilla [b]	10	250	0	0	20	0	0	0	280	180	90	0	0	0	0	270	13,540	14,090
Hardin	20	0	0	0	0	0	0	0	20	110	100	0	0	0	0	210	6,490	6,720
Hornitos [b]	0	0	0	0	0	0	0	0	0	180	10	0	0	0	0	190	15,170	15,360
Mariposa	10	0	0	0	10	0	0	0	20	100	70	0	0	0	0	170	4,580	4,770
White Rock	50	0	0	0	0	0	0	0	50	290	0	0	0	0	0	290	4,520	4,860
Subtotals	90	250	0	0	30	0	0	0	370	860	270	0	0	0	0	1,130	48,700	50,200
Merced																		
Baxter	390	0	0	0	0	0	0	0	390	310	0	0	0	0	0	310	3,840	4,540
Chowchilla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	590	590
Hornitos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,190	3,190
Subtotals	390	0	0	0	0	0	0	0	390	310	0	0	0	0	0	310	7,620	8,320
Nevada																		
Grass Valley	4,820	1,500	60	60	10	0	0	0	6,450	100	180	80	0	0	0	360	45,120	51,930
Spaulding	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10	3,360	3,370
Tyler	110	0	0	0	0	0	0	0	110	0	20	0	0	0	0	20	3,910	4,040
Subtotals	4,930	1,500	60	60	10	0	0	0	6,560	100	210	80	0	0	0	390	52,390	59,340
Placer																		
Colfax	280	3,420	0	0	0	0	0	0	3,700	0	610	90	0	0	0	700	11,000	15,400
Doty	5,650	6,330	100	130	0	290	70	0	12,570	3,570	1,030	30	0	0	20	4,650	32,170	49,390
Foresthill	0	10	0	0	0	0	0	0	10	0	10	0	0	0	0	10	15,360	15,380
Loomis	450	10,990	0	870	0	0	0	0	12,310	940	2,850	730	0	0	10	4,530	15,780	32,620
Subtotals	6,380	20,750	100	1,000	0	290	70	0	28,590	4,510	4,500	850	0	0	30	9,890	74,310	112,790

TABLE 9—Continued

PRESENT USE OF IRRIGABLE LANDS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

(Gross areas, in acres)

County and service area	Cultivated																Non-cultivated	Gross irrigable area
	Irrigated									Nonirrigated								
	Pasture	Deciduous orchard	Grain hay	Vines	Truck	Alfalfa	Citrus	Field crops	Total	Grain hay	Deciduous orchard	Vines	Truck	Alfalfa	Citrus	Total		
Sacramento																		
Carson	370	400	0	0	230	150	0	1,170	2,320	1,450	0	0	0	0	0	1,450	34,550	38,320
Laguna	310	140	0	10	100	30	0	300	890	3,500	0	0	0	0	0	3,500	44,050	48,440
Subtotals	680	540	0	10	330	180	0	1,470	3,210	4,950	0	0	0	0	0	4,950	78,600	86,760
San Joaquin																		
Arroyo Seco	360	50	40	30	80	0	0	0	560	4,670	20	120	0	0	0	4,810	11,260	16,630
Bear Creek	460	0	0	0	130	0	0	0	590	10,470	160	110	0	0	0	10,740	24,490	35,820
Subtotals	820	50	40	30	210	0	0	0	1,150	15,140	180	230	0	0	0	15,550	35,750	52,450
Stanislaus																		
Blanchard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,650	1,650
Keystone	0	20	0	0	0	0	0	0	20	0	0	0	0	0	0	0	610	630
Rock Creek	0	0	0	0	0	0	0	0	0	700	0	0	0	0	0	700	1,830	2,530
Subtotals	0	20	0	0	0	0	0	0	20	700	0	0	0	0	0	700	4,090	4,810
Tuolumne																		
Blanchard [c]	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	40	3,070	3,110
Groveland	0	0	0	0	0	0	0	0	0	570	100	0	0	0	0	670	10,200	10,870
Keystone [c]	20	0	0	0	0	0	0	0	20	270	0	0	0	0	0	270	11,610	11,900
Lyons	190	740	0	10	20	0	0	0	960	120	90	0	0	0	0	210	5,050	6,220
Phoenix	330	90	0	0	0	0	0	0	420	1,060	270	0	0	0	0	1,330	16,060	17,810
Subtotals	540	830	0	10	20	0	0	0	1,400	2,060	460	0	0	0	0	2,520	45,990	49,910
Yuba																		
Browns Valley	3,090	480	50	0	0	0	0	0	3,620	710	30	0	0	0	0	740	13,510	17,870
Challenge	630	130	20	0	0	0	0	0	780	70	40	0	0	0	0	110	24,120	25,010
Smartville	250	0	0	0	0	0	0	0	250	0	70	0	0	0	0	70	5,980	6,300
Strawberry	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	30	3,170	3,200
Subtotals	3,970	610	70	0	0	0	0	0	4,650	780	170	0	0	0	0	950	46,780	52,380
TOTALS	21,390	35,950	780	1,160	780	610	660	1,470	62,800	43,200	10,370	2,640	0	0	270	56,480	691,350	810,630

[a] Remainder of Rock Creek Service Area is listed under Stanislaus County.
[b] Remainder of Baxter, Chowchilla, and Hornitos Service Areas are listed under Merced County.
[c] Remainder of Blarchard and Keystone Service Areas are listed under Stanislaus County.

areas of smaller size were not excluded from large parcels of land mapped as irrigable. Similarly, isolated parcels of less than five acres in area were not mapped.

Present use of irrigable lands in the agricultural zone, as determined by the land use survey, is shown in Table 9, by service areas and counties. The data given in Table 9 are summarized graphically on Plate 12, entitled "Use of Irrigable Lands in the Agricultural Zone, 1948-1950." The plate shows the relation between present and potential development of agricultural lands, and points strongly to an ultimate crop pattern. The following statements are indicated:

1. Of the total area within the agricultural zone, slightly more than one-fifth is considered suitable for agricultural use.

2. Of the total area suitable for agricultural use, only 15 per cent has been brought under cultivation.

3. More than half the cultivated area is irrigated.

4. The present use of agricultural lands reflects an agricultural economy which is founded on fruit-growing and cattle-raising.

The data shown in Table 9 also reflect the great disparity in present agricultural development between the northern and southern sections of the region. This disparity is measured in the following tabulation:

Item	*Per cent of total*	
	Northern section	*Southern section*
Gross irrigable area	48	52
Present cultivated area	60	40
Present irrigated area	85	15
Present dry-farmed area	32	68

It is noted that more than half the total cultivated area and more than half the total irrigated area in the northern section of the region is located in Placer County, principally in the Auburn-Sheridan-Roseville

Cattle Grazing in Foothills of El Dorado County

Courtesy of El Dorado County Chamber of Commerce triangle. Placer County alone has more than three times the irrigated area of the entire southern section of the region.

The geographical distribution of irrigated and potentially irrigable lands in the agricultural zone, as determined by the land use and land classification survey, is indicated on Plate 13, entitled "Irrigated and Irrigable Lands in the Agricultural Zone, 1948-1950." Present urban areas of the larger towns are also shown. The plate illustrates the following conditions:

1. The great majority of the irrigated lands are in the northern half of the region.

2. The pattern of the irrigable lands is, in general, one of dispersion in fairly small parcels.

3. Most of the large bodies of irrigable lands are located at low elevations in the western part of the region.

Irrigated and Irrigable Areas in the National Forest Zone. So far as the national forest zone is concerned, no detailed data regarding present and potential land use were compiled. There is little agricultural development in the zone and there are no permanent urban areas of significance, although the populations of many of the resort areas are substantial during tourist seasons. General information regarding the extent of irrigated and potentially irrigable lands in the zone was obtained from the United States Forest Service. The data furnished by the Forest Service do not indicate the present use or the exact location of the irrigable lands. It is a matter of general knowledge, however, that virtually all irrigated lands in the zone are used for summer range for cattle, and that most of the irrigated crops consist of native grasses. The irrigable lands are located generally in small valley areas where the terrain is nearly flat and where water for irrigation use is available by direct diversion from local streams. Data regarding irrigated and irrigable lands in the national forest zone, segregated according to county boundaries, are presented in Table 10. The data support the basic contention that the national forest zone is not a potential agricultural zone of more than limited significance. It has been pointed out previously that small portions of the national forest areas were included within the area covered by the land use and land classification survey whenever such inclusions appeared logical. The areas indicated in Table 10, therefore, do not represent the total irrigable area within the national forest boundaries.

TABLE 10

IRRIGATED AND NONIRRIGATED IRRIGABLE LANDS IN THE NATIONAL FOREST ZONE, MOTHER LODE REGION

(In acres)

County	Presently irrigated area	Non-irrigated area	Total irrigable area
Amador	0	80	80
Butte	137	411	548
Calaveras	0	0	0
El Dorado	220	845	1,065
Mariposa	65	4	69
Nevada	1	85	86
Placer	19	613	632
Tuolumne	90	1,345	1,435
Yuba	130	62	192
TOTALS	662	3,445	4,107

Present Urban Areas. The extent of present urban areas in the agricultural zone was derived on the basis of estimates of present urban population and of average population density.

Present urban population in any service area was considered to be the aggregate of all cities, towns, and communities of more than 100 inhabitants. The present populations of the larger towns were taken from the 1950 United States Census. Populations of towns and communities too small to be listed in the census were taken from the 1951 California Roster of Public Officials, or from the 1946 California Blue Book. In the case of cities with populations of 2,500 or more, estimates of suburban population were added to the census figures for the area within the city limits. These estimates were based on ratios between voter registration, available for both city and suburban areas, and the population within the city limits as given by the 1950 United States Census. Such estimates permit a more realistic computation of present urban areas than could be obtained from census figures alone. In the case of Oroville, for instance, the population of the immediate suburban area was estimated to be about equal to that of the city proper.

Estimates of the present average population density in urban areas were based on the average density of all towns in the region with populations of 2,500 or more. These towns are Auburn, Grass Valley, Nevada City, Oroville, Placerville, and Sonora. The present population density, in persons per acre, was determined for each of these towns by dividing the 1950 census population by the populated area within city limits in acres. The populated area was measured from the latest maps available. In the case of Grass Valley and Oroville, the populated or built-up area was the same as the total area within the city limits. In all other cases, however, the populated area was considerably less than the total area within the city limits. The computations revealed present population densities ranging from 4.3 to 8.4 persons per acre, with an average density of 6.0 persons per acre.

Estimates of the present urban population and of the present urban area of each service area are presented in Table 11. Present urban area was obtained by dividing present urban population, including suburban, by the computed average density of 6.0 persons per acre.

TABLE 11

ESTIMATED PRESENT URBAN POPULATION AND PRESENT URBAN AREA IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

County and service area	Present urban population	Present urban area, in acres
Amador		
Ione	2,100	350
Jackson	4,450	740
Plymouth	750	130
Volcano	450	80
Subtotals	7,750	1,300
Butte		
Bidwell	150	30
Big Bend	350	60
Buckeye	0	0
Chico	0	0
Deer Creek	100	20
Magalia	2,250	380
Wyandotte	13,250	2,210
Subtotals	16,100	2,700
Calaveras		
Bear Mountain	400	70
Calaveras	1,800	300
Hogan	950	160
Mokelumne	1,100	180
Rock Creek	150	30
Stanislaus	2,450	410
West Point	300	50
Subtotals	7,150	1,200
El Dorado		
Aukum	300	50
Georgetown	1,450	240
Latrobe	450	80
Placerville	8,200	1,370
Youngs	600	100
Subtotals	11,000	1,840
Mariposa		
Baxter	0	0
Chowchilla	100	20
Hardin	400	70
Hornitos	200	30
Mariposa	650	110
White Rock	0	0
Subtotals	1,350	230
Merced		
Baxter	800	130
Chowchilla	0	0
Hornitos	0	0
Subtotals	800	130
Nevada		
Grass Valley	14,600	2,430
Spaulding	0	0
Tyler	400	70
Subtotals	15,000	2,500
Placer		
Colfax	10,200	1,700
Doty	2,400	400
Foresthill	1,150	190
Loomis	3,600	600
Subtotals	17,350	2,890
Sacramento		
Carson	1,850	310
Laguna	0	0
Subtotals	1,850	310
San Joaquin		
Arroyo Seco	0	0
Bear Creek	0	0
Subtotals	0	0
Stanislaus		
Blanchard	0	0
Keystone	0	0
Rockcreek	0	0
Subtotals	0	0
Tuolumne		
Blanchard	100	20
Groveland	900	150
Keystone	300	50
Lyons	3,200	530
Phoenix	5,650	940
Subtotals	10,150	1,690
Yuba		
Browns Valley	350	60
Challenge	750	130
Smartville	200	30
Strawberry	0	0
Subtotals	1,300	220
TOTALS	89,800	15,010

Estimates given in Table 11 show that present use of land for urban development is not significant, the total urban area being less than one-half of one per cent of the total area of the agricultural zone.

Summary of Present Land Use Pattern. The present land use pattern in the Mother Lode Region is presented in summary form in Table 12. Lands listed under the heading "Unclassified" were derived by subtracting all of the other classified areas from the total area of the unit concerned.

Probable Ultimate Land Use Pattern

Probable ultimate or maximum water requirements depend on ultimate land use patterns, or, in other words, on ultimate land use. The derivation of a probable ultimate land use pattern in the Mother Lode Region was accomplished according to the following criteria and procedures:

1. All lands in the region were considered to have a water requirement. Lands not classified as either irrigable or urban were grouped under the general category of "Other Water Service Areas."

2. The extent of the irrigable areas in the agricultural zone was determined by the land classification survey. The extent of irrigable areas in the national forest zone was based on data obtained from the United States Forest Service.

3. The probable use of the irrigable lands was estimated on the basis of the present crop pattern, as

TABLE 12

PRESENT LAND USE PATTERN, MOTHER LODE REGION

(Gross areas, in acres)

County and service area	Irrigated	Urban	Dry-farmed	Unclassified	Totals
Amador					
Ione	830	350	4,640	73,080	78,900
Jackson	0	740	760	78,200	79,700
Plymouth	40	130	1,710	40,020	41,900
Volcano	30	80	310	75,280	75,700
Subtotals, agricultural zone	900	1,300	7,420	266,580	276,200
National forest zone	0	0	0	104,000	104,000
Totals, county	900	1,300	7,420	370,580	380,200
Butte					
Bidwell	0	30	0	37,870	37,900
Big Bend	40	60	100	56,800	57,000
Buckeye	260	0	50	50,290	50,600
Chico	20	0	220	37,560	37,800
Deer Creek	0	20	120	47,660	47,800
Magalia	1,870	380	1,160	81,490	84,900
Wyandotte	3,990	2,210	1,310	109,690	117,200
Subtotals, agricultural zone	6,180	2,700	2,960	421,360	433,200
National forest zone	140	0	0	234,260	234,400
Totals, county	6,320	2,700	2,960	655,620	667,600
Calaveras					
Bear Mountain	0	70	1,000	92,630	93,700
Calaveras	230	300	720	153,450	154,700
Hogan	360	160	2,390	40,890	43,800
Mokelumne	250	180	450	81,620	82,500
Rock Creek	0	30	150	41,620	41,800
Stanislaus	810	410	990	82,290	84,500
West Point	100	50	230	31,520	31,900
Subtotals, agricultural zone	1,750	1,200	5,930	524,020	532,900
National forest zooe	0	0	0	125,100	125,100
Totals, county	1,750	1,200	5,930	649,120	658,000
El Dorado					
Aukum	0	50	150	57,600	57,800
Georgetown	1,580	240	740	113,040	115,600
Latrobe	0	80	200	19,620	19,900
Placerville	6,050	1,370	2,540	228,040	238,000
Youngs	0	100	150	45,550	45,800
Subtotals, agricultural zone	7,630	1,840	3,780	463,850	477,100
National forest zone	220	0	0	512,280	512,500
Totals, county	7,850	1,840	3,780	976,130	989,600
Mariposa					
Baxter	0	0	0	38,300	38,300
Chowchilla	280	20	270	123,430	124,000
Hardin	20	70	210	125,200	125,500
Hornitos	0	30	190	102,980	103,200
Mariposa	20	110	170	112,500	112,800
White Rock	50	0	290	56,660	57,000
Subtotals, agricultural zone	370	230	1,130	559,070	560,800
National forest zone	70	0	0	370,330	370,400
Totals, county	440	230	1,130	929,400	931,200
Merced					
Baxter	390	130	310	18,670	19,500
Chowchilla	0	0	0	2,400	2,400
Hornitos	0	0	0	32,300	32,300
Subtotals, agricultural zone	390	130	310	53,370	54,200
National forest zone	------	------	------	------	------
Totals, county	390	130	310	53,370	54,200
Nevada					
Grass Valley	6,450	2,430	360	209,960	219,200
Spaulding	0	0	10	40,290	40,300
Tyler	110	70	20	56,800	57,000
Subtotals, agricultural zone	6,560	2,500	390	307,050	316,500
National forest zone	0	0	0	197,300	197,300
Totals, county	6,560	2,500	390	504,350	513,800

TABLE 12—Continued

PRESENT LAND USE PATTERN, MOTHER LODE REGION

(Gross areas, in acres)

County and service area	Irrigated	Urban	Dry-farmed	Unclassified	Totals
Placer					
Colfax	3,700	1,700	700	83,600	89,700
Doty	12,570	400	4,650	77,580	95,200
Foresthill	10	190	10	83,090	83,300
Loomis	12,310	600	1,530	32,360	49,800
Subtotals, agricultural zone	28,590	2,890	9,890	276,630	318,000
National forest zone	20	0	0	374,580	374,600
Totals, county	28,610	2,890	9,890	651,210	692,600
Sacramento					
Carson	2,320	310	1,450	79,620	83,700
Laguna	890	0	3,500	82,510	86,900
Subtotals, agricultural zone	3,210	310	4,950	162,130	170,600
National forest zone	----	----	----	----	----
Totals, county	3,210	310	4,950	162,130	170,600
San Joaquin					
Arroyo Seco	560	0	4,810	22,130	27,500
Bear Creek	590	0	10,740	38,070	49,400
Subtotals, agricultural zone	1,150	0	15,550	60,200	76,900
National forest zone	----	----	----	----	----
Totals, county	1,150	0	15,550	60,200	76,900
Stanislaus					
Blanchard	0	0	0	7,600	7,600
Keystone	20	0	0	7,980	8,000
Rock Creek	0	0	700	12,400	13,100
Subtotals, agricultural zone	20	0	700	27,980	28,700
National forest zone	----	----	----	----	----
Totals, county	20	0	700	27,980	28,700
Tuolumne					
Blanchard	0	20	40	35,740	35,800
Groveland	0	150	670	58,180	59,000
Keystone	20	50	270	76,660	77,000
Lyons	960	530	210	56,500	58,200
Phoenix	420	940	1,330	80,610	83,300
Subtotals, agricultural zone	1,400	1,690	2,520	307,690	313,300
National forest zone	90	0	0	1,142,610	1,142,700
Totals, county	1,490	1,690	2,520	1,450,300	1,456,000
Yuba					
Browns Valley	3,620	60	740	41,980	49,400
Challenge	780	130	110	101,980	103,000
Smartville	250	30	70	18,350	18,700
Strawberry	0	0	30	16,670	16,700
Subtotals, agricultural zone	4,650	220	950	181,980	187,800
National forest zone	130	0	0	43,670	43,800
Totals, county	4,780	220	950	225,650	231,600
TOTALS, AGRICULTURAL ZONE	62,800	15,010	56,480	3,611,910	3,746,200
TOTALS, NATIONAL FOREST ZONE	670	0	0	3,104,130	3,104,800
TOTALS, REGION	63,470	15,010	56,480	6,716,040	6,851,000

determined by the land use survey, and on the basis of a study of crop adaptability in the region.

4. The probable ultimate urban area was computed on the basis of estimates of ultimate urban population and of ultimate urban population density.

Land Classification. The land classification survey conducted for this investigation was initiated in 1947 and completed in 1950. Criteria were established to govern the classification of irrigable lands, and these are described in the ensuing discussion.

Suitability of lands for agricultural use is dependent upon climate, soil, topography, and drainage. Climatic conditions of the area classified are highly variable, but generally the controlling factor is elevation. With an increase of elevation, there is an increase in mean annual precipitation and a decrease in mean annual temperature and length of growing season. Precipitation in the area also increases from south to north. These varying climatic conditions have greatly influenced soil formation and, with the extremely variable geological materials, account for the great variations in soil types.

Potential utility of the lands is influenced by both the general climatic conditions and the highly variable local climatic conditions. General climatic conditions largely determine the upper limit of crop agriculture. With an increase in altitude, the lower mean annual temperature decreases the length of the growing season, and the danger of frost during the late spring and early fall is increased. Variable local climatic conditions, such as humidity, winds, exposure, cold air drainage from mountain snow fields, and frost pockets, are factors related to local topography. Because of the variability of these climatic conditions, no attempt was made to correlate local factors with the land classification.

Physical characteristics of soil texture, depth, structure, and inherent fertility, as related to the parent geological material, to a large extent determine root zone area, moisture-holding capacity, base exchange capacity of available nutrients in the soil, and ease of cultivation. In the surveys, the nature of the underlying parent material was also to be considered in relation to soil depth. In cases where shallow soils were developed on shattered bedrock, such as slates encountered in the Calaveras and Mariposa formations, which would not impede penetration of roots and would hold considerable moisture, the effective root depth was considered to be greater than that of shallow soils overlying massive bedrock.

Topographic conditions considered were degree of slope and undulation. These conditions largely determine ease of irrigation, or the type of irrigation required to provide water to cropped land at a proper rate to permit the soil to absorb and hold moisture without erosion or excessive losses through runoff or percolation. As a general rule, no lands with smooth slopes in excess of a 30-foot rise in a 100-foot horizontal distance were considered to be suitable for development by irrigation. As the topographic undulation and roughness increased, the allowable maximum general slopes were decreased.

Drainage and high water table, with attendant alkali intrusions, are not important factors in irrigation development of the foothill lands. In most cases, there is good surface and internal drainage. There are small depressed areas where seepage and local drainage may be a problem, but corrective measures can usually be achieved without extensive drainage systems.

In order to obtain a more permanent land classification not appreciably affected by changing economic conditions, standards were established based upon the more stable physical factors and inherent conditions that affect the suitability of the land for irrigation development. The various land classes do not necessarily reflect relative economic value or returns to be obtained. Lands having shallow or medium-depth soils may under certain conditions give as great or greater returns than can be obtained from lands having deep soils.

Economic factors relating to the development, production, or marketing of adaptable crops were not considered in the classification, nor were costs of clearing, leveling, or other operations required to prepare land for cultivation. Classification was predicated on the ultimate potential of the land without regard to availability of water or present land utilization, although this latter factor, in the few instances where irrigation was practiced, was helpful in establishing the appropriate land class for similar soils. Presence of loose rock or rock outcropping was considered in the classification insofar as they would affect productivity by reducing effective tillable areas.

With the foregoing criteria in mind, land classification nomenclature was established. Table 13 sets forth, for the six classes of agricultural lands, the criteria used in selecting the appropriate symbol for a particular body of land. Classes 1, 2, and 3 approach valley types of land, and are found along the western boundary of the area and at isolated locations along stream channels. Class 4 lands in their various phases are found in the more mountainous areas extending up to the climatic limit of agriculture. Class 5 (P) lands are those just meeting the minimum requirements for irrigated agriculture, and are limited to irrigated pasture. Class 6 includes all other lands not falling within the other classes.

The land classification survey initiated in 1947 was in the nature of a detailed reconnaissance. The area was covered as completely as public roads, farm roads, and trails would permit. Stereoscopic aerial photographs were used for field mapping purposes. As the classification was determined, the area was delineated in the field on the aerial photographs, which had a scale of about three inches to the mile. The minimum area that could be segregated from a larger area was limited by the scale of the photographs, so that nonirrigable areas of less than 5 to 10 acres were not excluded from the main bodies of arable land. Conversely, small isolated tracts of agricultural land of equal size were not mapped.

The reasons for placing areas in a lower class than "1" were indicated on the photographs by the letters "s," "t," or "d" after the classification number, depending on whether the deficiency was depth of soils, topography, drainage, or combinations thereof.

The character of the soils was established by means of test holes, examination of road cuts, and by observation of the character and quality of the natural vegetation or crops being grown. The classification standards were applied in the field to carefully observed soil characteristics, topographic features, and drainage conditions. The various land classes and the factors defining each class are described as follows:

Class 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture, and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and of good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth-lying with gentle slope.

Class 2 comprises lands that are generally limited to climatically adapted, medium-deep-rooted crops, due to the restrictive features of the soil depth and to a minor extent to topography or drainage. They are well suited for development under irrigation.

Class 3 comprises lands that are generally limited to climatically adapted, shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

Class 4(2) comprises lands that fail to meet the standards for the preceding land classes, especially with regard to topographic conditions. Class 4(2) land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography. These lands are suitable, through special irrigation practices, for the production of certain crops not precluded by climatic conditions. Owing to their more rolling topography they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation. Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops. In coarse-textured granitic soils, rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops.

Class 4(3) comprises lands which fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4(2) lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow-rooted orchards as almonds and olives and for permanent pasture. However, irrigation on the steep slopes would require great skill and care, or relatively expensive sprinkler system installations. On the deeper phases of this class, where the only limitation is slope or undulation, deeper-rooted orchards may be cultivated.

Class 5(P) comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigation than preceding classes.

Class 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

Standards upon which lands were segregated according to class are presented in Table 13.

The results of the land classification survey are delineated on the 27 sheets comprising Plate 14, entitled "Classification of Lands in the Agricultural Zone, 1948-1950." The index to Plate 14 shows the portion of the region covered by each of the 27 sheets. With regard to the exact location and areal extent of any particular parcel of land, it should be pointed out that the land classification plates do not possess the detail of the aerial photographs on which the irrigable lands were mapped in the field. These photographs are on file in the Division of Water Resources, and may be inspected on request. The land classification plates are intended to show generally the type, location, and extent of the irrigable lands in the Mother Lode Region.

The report of a highly qualified board which made an independent review of the land classification standards, the survey procedure, and the degree of conformity of the field work with the established standards, is presented in Appendix D. Members of the board were:

- Dr. Ralph C. Cole, Chief, Land Classification Section, Bureau of Reclamation, Region 2, United States Department of the Interior.
- Robert A. Gardner, Senior Soil Correlator, Division of Soil Survey, United States Department of Agriculture.
- Walter W. Weir, Drainage Engineer, Division of Soils, College of Agriculture, University of California.

The irrigable areas shown on Plate 14 are gross areas. It was considered that it would not be practicable, even under the most intensive development, to cultivate and irrigate all of each parcel of irrigable land. The maximum area which could be cultivated and irrigated is called "net irrigable area." In order to evaluate net irrigable areas, it was necessary to assign values to the various factors which operate to reduce gross irrigable areas. These factors are identified and described as follows:

1. Quality of irrigable land—It was concluded that even under conditions of ultimate agricultural development, high-quality lands will be cultivated more continuously and more intensively than lands of poorer quality.

TABLE 13

LAND CLASSIFICATION STANDARDS

Land characteristics	Class 1	Class 2	Class 3	Class 4(2)	Class 4(3)	Class 5(P)	Class 6
Soils							
Texture	Sandy loam to friable clay loam.	Loamy sand to very permeable clay.	Loamy sand to permeable clay.	Sandy loam to permeable clay.	Sandy loam to permeable clay.	Sandy loam to permeable clay.	Includes all other lands which do not meet the minimum requirements for the preceding classes.
Depth							
Over open permeable subsoils	42 inches or more of sandy loam or 36 inches or more of fine sandy loam or finer textured soil.	36 inches or more of loamy sand or 24 inches or more of fine sandy loam or finer textured soil.	30 inches or more of loamy sand or 18 inches of finer textured soil.	24 inches or more of good free-working soil over shattered bedrock.	15 inches or more of good free-working soil over shattered bedrock.	9 inches or more of good free-working soil over shattered bedrock.	
Over shale, hardpan, or massive bedrock	48 inches or more of good free-working soil.	36 inches or more of good free-working soil.	24 inches or more of good free-working soil.	30 inches or more of good free-working soil over massive bedrock.	24 inches or more of good free-working soil over massive bedrock.	15 inches or more of good free-working soil over massive bedrock.	
Topography							
Slopes	Smooth slopes up to 2 percent in general gradient, in reasonably large-sized bodies sloping in the same plane.	Smooth slopes up to 6 percent in general gradient, in reasonably large-sized bodies sloping in the same plane; or rougher slopes which are less than 2 percent in general gradient.	Smooth slopes up to 6 percent in general gradient, in reasonably large-sized bodies sloping in the same plane; or rougher slopes which are less than 4 percent in general gradient.	Smooth slopes up to 20 percent in general gradient, in reasonably large-sized bodies sloping in the same plane; or rougher slopes which are less than 12 percent in general gradient.	Smooth slopes up to 30 percent in general gradient, in reasonably large-sized bodies sloping in the same plane; or rougher slopes which are less than 20 percent in general gradient.	Smooth slopes up to 30 percent in general gradient, in reasonably large-sized bodies sloping in the same plane; or rougher slopes which are less than 20 percent in general gradient.	
Cover (Loose rocks and rock outcroppings)	Insufficient to modify productivity or land use practices.	Sufficient to slightly reduce productivity and interfere with land use practices.	Sufficient to moderately reduce productivity and interfere with land use practices.	Sufficient to slightly reduce productivity and interfere with land use practices.	Same as Class 4(2) except where soils are deep. In that case, cover to moderately reduce productivity and interfere with land use practices is permitted.	No more than to slightly reduce productivity and interfere with land use practices.	
Erosion	None.	None.	None.	Little or no erosion: may have occasional gullies which are erossable by tillage implements.	Moderate erosion but with very few gullies which are not crossable by tillage implements.	Moderate erosion but with very few gullies which are not crossable by tillage implements.	
Drainage							
Soil and topography	Soil and topographic conditions such that no specific farm drainage requirement is anticipated.	Soil and topographic conditions such that some farm drainage will probably be required, but at reasonable cost.	Soil and topographic conditions such that some farm drainage will probably be required, but at reasonable cost.	Drainage not a factor.	Drainage not a factor.	Drainage not a factor.	

2. Encroachments—Some irrigable lands are and will be occupied by rights of way for railroads, highways, and canals. Others will be encompassed by urban development, and some will be occupied by farm houses, buildings, fences, roads, and other installations.

3. Inclusions of nonirrigable land—The extent of inclusions of small areas of nonirrigable land within parcels mapped and classified as irrigable was dependent on the detail of the land classification survey. There was a greater chance for such inclusions when mapping marginal land classes. Exclusion of irrigable land within nonirrigable areas constitutes a much smaller error, since these exclusions were small and could not be utilized as economic units.

4. Size, shape, and location of irrigable lands—Small, irregularly shaped parcels of land cannot be irrigated as easily or as completely as large, compact units. Small plots isolated from probable canal routes by distance or elevation may never be irrigated.

5. Climatic conditions—Where rainfall is sufficient to support dry farming, it is possible that some lands will always be dry-farmed. For example, it is known that farmers in some localities would prefer not to irrigate their vineyards even if water were available. Length of growing season and danger of unseasonal frosts are also factors which influence irrigation development.

6. Economic factors—The economic factors of supply, demand, and marketing will affect the development of irrigable land.

It was not possible to evaluate all of these factors, especially under conditions of ultimate development. For purposes of this bulletin, only the first three of the above factors were considered to be operative. The effect of these factors in reducing gross irrigable areas is shown in Table 14. Net irrigable area was determined by applying the combined factors shown in the table to the gross irrigable areas of each land class.

TABLE 14

FACTORS APPLIED TO GROSS IRRIGABLE AREA TO OBTAIN NET IRRIGABLE AREA BY LAND CLASS

(In per cent of gross irrigable area)

Land class	Encroachments	Quality of land and inclusion of nonirrigable land	Combined
1	93	97	90
2	94	92	86
3	95	87	83
4(2)	96	90	86
4(3)	96	83	80
5(P)	96	69	66

Results of the land classification survey are shown in Table 15, which presents gross areas of each class of irrigable land, compiled according to service area and county boundaries. The table also indicates the total net irrigable area in each service area and county.

Crop Adaptability. The land classification survey indicated that the maximum area which is suitable for irrigation in the Mother Lode Region is 650,000 acres. The next question to be answered before an ultimate crop pattern can be derived is: What crops can be grown successfully on these irrigable lands? The range of possibilities is limited by topography, climate, and by the physical and chemical properties of soils. Of the latter, the most important property limiting the utility of irrigable land is the depth of soil. However, all of these factors, except that of climate, were used directly in establishing standards to govern the classification of irrigable lands. In the Mother Lode Region, the principal restriction imposed by climate is that the quantity of available heat, particularly in the higher elevations, is insufficient for the growing of many crops. On the average, the growing season in the agricultural zone of the region is sufficiently long, even in the higher elevations, to support almost any crop which can be grown in valley floor areas, except those which require more heat than is available in mountain areas, for example, cotton and rice. The length of the growing season, however, is highly variable from year to year. Damaging frosts often occur in many areas as late as June and as early as September. Since the climate in the region becomes more severe as elevation increases, elevation is in itself a measure of the influence of climate on crop adaptability.

Table 16 lists the various crops which are considered suitable to be grown on different classes of irrigable land in different zones of elevation. The suitability of any crop on any class of land was determined first on the basis of such physical and chemical properties of soils as depth, texture, and degree of acidity. The segregation of crops by zones of elevation was derived largely on the basis of consultations and discussions with farmers and county farm advisers in the Mother Lode Region, and with the advice of agricultural specialists of the University of California.

It is noted in Table 16 that the use of classes 4(2) and 4(3) lands for the growing of certain crops is limited to the deeper soil phases of those lands. In the previous discussion of land classification standards it was pointed out that irrigable lands may be classified as 4(2) or as 4(3) for reasons of soil depth or of topography, or for a combination of the two. Due largely to the soil-producing action of precipitation, which increases as elevation increases, soils in the Mother Lode Region generally are deeper at the higher elevations. At low elevations the principal factor limiting the crop adaptability of classes 4(2) and 4(3) lands is that of soil depth. At higher elevations, however, many irrigable lands have deep soils, but

TABLE 15

CLASSIFICATION OF IRRIGABLE LANDS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

(In acres)

County and service area	Gross areas by land classes						Totals	
	1	2	3	4(2)	4(3)	5(P)	Gross area	Estimated net area
Amador								
Ione	5,210	5,800	2,140	4,150	6,830	13,900	38,030	29,700
Jackson		680	370	1,580	5,830	2,130	10,590	8,400
Plymouth	30	510	50	3,960	4,660	650	9,860	8,100
Volcano		240	10	4,530	4,380	80	9,240	7,700
Subtotals	5,240	7,230	2,570	14,220	21,700	16,760	67,720	53,900
Butte								
Bidwell		20		1,500	3,650		5,170	4,300
Big Bend			30	950	2,500	620	4,100	3,300
Buckeye		20		2,970	2,190		5,180	4,400
Chico		120	150	2,360	870	190	3,690	3,100
Deer Creek		40	40	3,840	830	30	4,780	4,100
Magalia		1,320	880	11,700	4,030	1,420	19,350	16,100
Wyandotte	650	1,500	2,520	8,970	17,100	3,290	34,030	27,600
Subtotals	650	3,020	3,620	32,290	31,170	5,550	76,300	62,900
Calaveras								
Bear Mountain		3,910	640	1,420	1,890	13,440	21,300	15,500
Calaveras	170	1,000	60	6,930	5,400	3,150	16,710	13,400
Hogan	1,760	7,070		9,020	2,210	2,140	22,200	18,600
Mokelumne	300	2,510	220	4,300	3,970	4,780	16,080	12,700
Rock Creek	70	900	90	1,130	2,160	1,620	5,970	4,700
Stanislaus		1,760	30	6,000	1,840	3,720	13,350	10,700
West Point		130		2,350	660		3,140	2,700
Subtotals	2,300	17,280	1,040	31,150	18,130	28,850	98,750	78,300
El Dorado								
Ankum		110		4,510	5,830		10,450	8,700
Georgetown		660	30	5,200	7,430	2,270	15,590	12,500
Latrobe	290		1,070		3,060	2,140	6,560	4,900
Placerville	480	4,390	340	20,810	22,260	2,620	50,900	42,000
Youngs		30		2,480	4,890		7,400	6,100
Subtotals	770	5,190	1,440	33,000	43,470	7,030	90,900	74,200
Mariposa								
Baxter		30	250	290	1,370	2,460	4,400	3,200
Chowchilla		230	110	3,210	9,630	910	14,090	11,400
Hardin		480	10	3,230	2,460	540	6,720	5,600
Hornitos		120	550	300	8,150	6,240	15,360	11,500
Mariposa				900	2,540	1,330	4,770	3,700
White Rock		160	370	1,130	1,300	1,900	4,860	3,800
Subtotals		1,020	1,290	9,060	25,450	13,380	50,200	39,200
Merced								
Baxter	140	700	560	620	720	1,800	4,540	3,500
Chowchilla		120	80		70	320	590	500
Hornitos			100		230	2,860	3,190	2,200
Subtotals	140	820	740	620	1,020	4,980	8,320	6,200
Nevada								
Grass Valley		1,840	210	15,420	32,310	2,150	51,930	42,300
Spaulding				1,910	1,460		3,370	2,800
Tyler		170	40	760	2,880	190	4,040	3,300
Subtotals		2,010	250	18,090	36,650	2,340	59,340	48,400
Placer								
Colfax		110	50	5,240	10,000		15,400	12,700
Doty		5,850	2,660	15,170	20,240	5,470	49,390	40,100
Foresthill				13,180	2,200		15,380	13,100
Loomis		1,230	610	20,350	10,050	380	32,620	27,400
Subtotals		7,190	3,320	53,940	42,490	5,850	112,790	93,300
Sacramento								
Carson	2,640	3,830	6,670	950	4,900	19,330	38,320	28,700
Laguna	1,970	4,050	9,340	480	12,040	20,560	48,440	36,700
Subtotals	4,610	7,880	16,010	1,430	16,940	39,890	86,760	65,400

TABLE 15—Continued

CLASSIFICATION OF IRRIGABLE LANDS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

(In acres)

County and service area	Gross areas by land classes						Totals	
	1	2	3	4(2)	4(3)	5(P)	Gross area	Estimated net area
San Joaquin								
Arroyo Seco	1,250	1,690	2,120	2,030	6,980	2,560	16,630	13,400
Bear Creek	1,370	1,290	70	15,870	10,560	6,660	35,820	28,900
Subtotals	2,620	2,980	2,190	17,900	17,540	9,220	52,450	42,300
Stanislaus								
Blanchard		80	40	240	240	1,050	1,650	1,200
Keystone		180	100	30	120	200	630	500
Rock Creek		40	160	160	1,140	1,030	2,530	1,900
Subtotals		300	300	430	1,500	2,280	4,810	3,600
Tuolumne								
Blanchard	10	330	40	690	520	1,520	3,110	2,400
Groveland	70	350		3,470	6,980		10,870	9,000
Keystone	160	1,690	220	4,460	1,910	3,460	11,900	9,500
Lyons	150	1,090	80	3,030	1,870		6,220	5,300
Phoenix	80	2,210	400	6,660	5,910	2,550	17,810	14,500
Subtotals	470	5,670	740	18,310	17,190	7,530	49,910	40,700
Yuba								
Browns Valley	440	1,140	2,370	1,360	6,080	6,480	17,870	13,700
Challenge		1,300	120	9,270	13,530	790	25,010	20,600
Smartville				800	2,600	2,900	6,300	4,700
Strawberry				670	2,530		3,200	2,600
Subtotals	440	2,440	2,490	12,100	24,740	10,170	52,380	41,600
TOTALS	17,240	63,030	36,000	242,540	297,990	153,830	810,630	650,000

TABLE 16

ESTIMATED CROP ADAPTABILITY BASED ON LAND CLASSIFICATION AND CLIMATE IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

Crop	Land classes		
	From lower limit of survey to 1,000-foot elevation	From 1,000-foot to 2,000-foot elevation	From 2,000-foot elevation to upper limit of survey
Alfalfa	1, 2	1, 2, 4(2)*	
Almonds	1, 2, 3, 4(2)		
Apples			1, 2, 4(2), 4(3)*
Berries			1, 2, 4(2), 4(3)
Cherries		1, 2, 4(2), 4(3)*	
Chestnuts		1, 2, 4(2)*, 4(3)*	
Grapes	1, 2, 4(2), 4(3)	1, 2, 4(2), 4(3)	
Field and truck crops	1, 2, 3	1, 2, 3	1, 2, 3
Irrigated pasture	All classes	All classes	All classes
Olives	1, 2, 3, 4(2)		
Oranges	1, 2, 4(2)		
Peaches	1, 2, 4(2)	1, 2, 4(2), 4(3)*	
Pears	1, 2, 4(2)	1, 2, 4(2), 4(3)*	1, 2, 4(2), 4(3)*
Plums	1, 2, 4(2)	1, 2, 4(2), 4(3)*	1, 2, 4(2), 4(3)*
Walnuts	1, 2	1, 2, 4(2)*, 4(3)*	1, 2, 4(2)*, 4(3)*

* Suitable only on deeper soil phases.

topographic limitations dictate their classification as 4(2) or 4(3). Such lands constitute the deeper phases of classes 4(2) and 4(3) lands, and a greater variety of crops can be grown on these lands than on other lands of the same classification which have shallower soils.

Obviously, there will be many exceptions to any zonal grouping of crops such as that shown in Table 16. Local variations in such climatic factors as humidity, winds, exposure, and air drainage were not considered, but these factors will make for exceptions. These thermal conditions become more important at higher elevations where, for example, class 4(2) lands may be better adapted to the growing of orchard and vines than class 1 lands. This may be true because the former lands are generally located on ridges and hillsides where air drainage is good, while the latter are usually situated in small valley floor areas where frost pockets are more prevalent.

Probable Ultimate Crop Pattern. The summary of crop adaptability given in Table 16 indicates that a wide variety of crops can be grown in the Mother Lode Region. The extent to which any of the crops listed can be developed, however, is limited by two fundamental factors, one physical, the other economic. These factors are:

1. The amount of land which is physically and climatically suitable for growing the crop.

2. Economic competition from agricultural areas on the floor of the Central Valley.

Dry-farmed Hay Field, Near Shingle Springs, El Dorado County

Courtesy of El Dorado County Chamber of Commerce

The first of these factors is self-explanatory. The second is more complex and difficult to evaluate. In general, but not always, it would be difficult for the mountainous areas to compete with valley floor areas in the production and marketing of any crop which is being intensively developed in the Central Valley. The latter area is adapted to large-scale, concentrated development, enjoys ready access to markets, and has definite advantages of climate, soils, and topography for raising many crops which also can be grown in the Mother Lode Region.

On the basis of the data given in Table 16, and in consideration of the restrictive factors just mentioned, it appears that deciduous orchards, olives, vines, irrigated pasture, and hay and grain are the principal crops suitable for the Mother Lode Region. It is possible to raise citrus fruits at low elevations; in fact, a few acres are planted to these crops now. Citrus fruits are highly susceptible to frost damage, however, and occasional severe winters such as those of 1932, 1937, and 1949 are seriously damaging to the trees as well as to the fruit. For this reason, and also because the irrigable area suitable for citrus fruit is small, it was considered that citrus orchards will not become a major part of the agricultural pattern in the region. The development of field and truck crops is limited by the fact that less than 15 per cent of the irrigable lands in the region are considered suitable for such crops. These lands are also suitable for other crops, and in instances where a small area of high-grade land is surrounded by large areas of inferior land, it is probable that the development of the larger area will dictate that of the smaller. The fact that field and truck crops are grown in large quantities on the floor of the Central Valley is unfavorable to the development of such crops in the Mother Lode Region, particularly when no extensive development of this type is possible in the region. The growing of alfalfa, which generally requires deep soils and level land for successful cultivation, is also restricted by the lack of suitable land.

All of the other crops listed in Table 16 are susceptible to comparatively large-scale development, especially pears, plums, walnuts, and grapes. Apples offer favorable possibilities, since they are most successful in colder climates. The most adaptable of all the crops, however, is irrigated pasture, which can be grown on all classes of land at all elevations. It is pointed out, also, that large areas of the Mother Lode Region which are unsuited for cultivation are used for dry-land range for cattle and sheep, and the development of irrigated pasture to supplement dry feed is now and will continue to be in the future a logical use of irrigable land.

It was considered that the best possibilities for irrigated agriculture in the Mother Lode Region probably lie in the development of irrigated pasture, deciduous orchards, olives, and hay and grain. This statement is supported in part by the results of the land use survey. As indicated on Plate 12, the survey shows that deciduous orchards and olives account for 57 per cent of all irrigated crops in the region today, and that irrigated pasture accounts for 34 per cent. It is significant that only nine per cent of the total irrigated area is devoted to all other crops combined, including field and truck crops, citrus orchards, and vines. The present crop pattern reflects economic and physical influences on agriculture in the region, and constitutes the basis for deriving a probable ultimate agricultural pattern.

The purpose of specifying a probable ultimate crop pattern was not to attempt to foresee or to recommend the future agricultural development of the region, but rather to provide a basis for the determination of maximum water requirements for irrigation purposes. For this reason, no attempt was made to specify that so many acres will be devoted to peaches or to pasture or to any other crop. On the basis of the present crop pattern, which reflects a century of experience and experiment in the region, and on the basis of the climatic and physical factors previously discussed, it was assumed for purposes of this bulletin that the probable ultimate crop pattern in the region will consist of irrigated pasture, deciduous orchards, olives, and hay and grain. For simplicity, the term "Orchard," as used hereafter in this bulletin, means deciduous orchards and includes olives. It is certain, of course, that other crops, such as field and truck crops, citrus, and vines, will be raised in small quantities in the future, as they are today.

It is a matter of common knowledge that different crops require different quantities of water. It could be argued, consequently, that the omission of crops other than those assumed for the ultimate pattern would result in erroneous estimates of ultimate water requirements. This would be true if the acreage which could reasonably be devoted to such crops were a substantial part of the total irrigable area. The land use survey shows, however, that all crops other than orchards and irrigated pasture occupy only nine per cent of the present irrigated area, and there is little evidence to indicate that they will occupy a substantial portion of the irrigable land in the future other than for the cultivation of irrigated hay and grain. It is believed, therefore, that the omission of crops other than orchards, irrigated pasture, and hay and grain from the assumed ultimate crop pattern will not substantially affect the estimates of ultimate water requirements.

The next question which arises is: What percentage of the irrigable lands should be chosen for each of the various crops assumed for the ultimate pattern? These percentages would vary from service area to service area. However, based on studies made for the State-wide Water Resources Investigation, it was considered that of the total irrigable land in the Mother Lode Region about 49 per cent would be devoted to pasture, 21 per cent to hay and grain, 10 per cent to orchard, and 20 per cent to other crops.

Probable Ultimate Urban Area. Estimates of probable ultimate urban areas were made for the agricultural zone only. It has been pointed out previously that there is no permanent urban area of significance within the national forest zone. Many of the resort areas have substantial populations during tourist and recreational seasons, but the designation of such areas as urban was not considered justified on this basis alone. It was considered probable that the future will not bring urban development of significance to the national forest zone, and that the segregation of all lands in the zone according to the categories of "Irrigable Areas" and "Other Water Service Areas" is sufficient for purposes of establishing both ultimate land use and ultimate water requirements.

So far as the agricultural zone is concerned, there can be no doubt that substantial increases in urban development will occur as the resources of the region, particularly its irrigable lands, are developed. If the principal bases of an expanded future economy are considered to be agriculture, lumbering, and mining, it does not appear that urban development in the region can reach really large proportions such as would be expected in industrial and manufacturing areas. This concept is supported by the indications that the principal field of economic expansion is in

TABLE 17

ESTIMATED ULTIMATE URBAN POPULATION AND ULTIMATE URBAN AREA IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

County and service area	Ultimate urban population	Ultimate urban area, in acres
Amador		
Ione	8,400	840
Jackson	17,800	1,780
Plymouth	3,000	300
Volcano	1,800	180
Subtotals	31,000	3,100
Butte		
Bidwell	600	60
Big Bend	1,400	140
Buckeye	0	0
Chico	0	0
Deer Creek	400	40
Magalia	9,000	900
Wyandotte	53,000	5,300
Subtotals	64,400	6,440
Calaveras		
Bear Mountain	1,600	160
Calaveras	7,200	720
Hogan	3,800	380
Mokelumne	4,400	440
Rock Creek	600	60
Stanislaus	9,800	980
West Point	1,200	120
Subtotals	28,600	2,860
El Dorado		
Aukum	1,200	120
Georgetown	5,800	580
Latrobe	1,800	180
Placerville	32,800	3,280
Youngs	2,400	240
Subtotals	44,000	4,400
Mariposa		
Baxter	0	0
Chowchilla	400	40
Hardin	1,600	160
Hornitos	800	80
Mariposa	2,600	260
White Rock	0	0
Subtotals	5,400	540
Merced		
Baxter	3,200	320
Chowchilla	0	0
Hornitos	0	0
Subtotals	3,200	320
Nevada		
Grass Valley	58,400	5,840
Spaulding	0	0
Tyler	1,600	160
Subtotals	60,000	6,000
Placer		
Colfax	40,800	4,080
Doty	9,600	960
Foresthill	4,600	460
Loomis	14,400	1,440
Subtotals	69,400	6,940
Sacramento		
Carson	7,400	740
Laguna	0	0
Subtotals	7,400	740
San Joaquin		
Arroyo Seco	0	0
Bear Creek	0	0
Subtotals	0	0
Stanislaus		
Blanchard	0	0
Keystone	0	0
Subtotals	0	0
Tuolumne		
Blanchard	400	40
Groveland	3,600	360
Keystone	1,200	120
Lyons	12,800	1,280
Phoenix	22,600	2,260
Subtotals	40,600	4,060
Yuba		
Browns Valley	1,400	140
Challenge	3,000	300
Smartville	800	80
Strawberry	0	0
Subtotals	5,200	520
APPROXIMATE TOTALS FOR REGION	360,000	36,000

agriculture. Lumbering may stabilize at or near its present level of activity, and mining is not expected to approach the level it once enjoyed. Present development of agriculture in the region is only a small fraction, however, of the potential development.

The areal extent of the probable ultimate urban development in the region was estimated on the basis of the following assumptions:

1. Urban development will be limited to the agricultural zone only.
2. The present urban population, as indicated in Table 1, will quadruple.
3. Urban population density will increase from its present average value of six persons per acre to an ultimate value of ten persons per acre.

While these assumptions are essentially arbitrary, it is believed that they allow reasonable estimates of ultimate urban area, and also of ultimate urban water requirements, both of which are very small in comparison to land use and water requirements for irrigation purposes. Estimates of probable ultimate urban population and urban areas, computed according to the foregoing assumptions, and compiled by service areas and counties, are listed in Table 17.

Summary of Ultimate Land Use Pattern. One of the primary objectives of this bulletin is the development of reasonable estimates of ultimate, or maximum, water requirements in the Mother Lode Region. Ultimate water requirements depend on the ultimate pattern of land use. An ultimate pattern based on anything less than maximum use of all lands in the region would result, obviously, in estimates of water requirements less than the maximum. For this reason, the ultimate land use pattern presented in this bulletin is based on the following basic criteria:

1. All lands in the region are considered as water-using areas, the degree of use depending on their classification as either irrigable or urban, or as "Other Water Service Areas."
2. All of the net irrigable areas are listed as irrigated areas, since any other assumption would result in estimates of water requirement less than the maximum for such lands.

It is emphasized that this procedure is followed solely for the purpose of formulating estimates of ultimate water requirements. While ultimate water requirements imply maximum use of all lands, it does not follow that such development is probable, or even possible in all areas. In some areas, maximum land use and maximum water requirements may some day be realized. It is entirely possible, however, that many service areas may never achieve such development. It should not be inferred, therefore, that the ultimate land use pattern presented herein represents a forecast of probable development. It is merely an evaluation of maximum development. The ultimate land use pattern in the Mother Lode Region, derived according to the foregoing basic assumptions, and according to the surveys and studies previously discussed, is presented in Table 18.

Unit Use of Water

For purposes of this bulletin, the term "Unit Use of Water" signifies the seasonal quantity of applied water which is consumptively used by irrigated crops or by other types of water-consuming culture. Unit use of irrigation water may be expressed as acre-feet per acre or as a depth of water, but in this bulletin the latter expression is used. In the case of urban and habitable areas, unit use is expressed as gallons per capita per day. Unit use of water factors were not evaluated for certain miscellaneous uses of water. Since those uses are in every case of a special nature and minor extent, allowances for such uses were made on an arbitrary, quantitative basis.

To evaluate water requirements, unit use of water factors must be calculated. The methods and procedures followed in this investigation in the derivation of unit use of water factors, and the results obtained, are described in the ensuing discussion.

Irrigation Water. Reliable information concerning actual quantities of applied water consumptively used by irrigated crops in the Mother Lode Region is meager. For this reason it was necessary to devise methods of estimating such use of water. The use of water by any irrigated crop is different in different localities. This variation is due to the fact that differences in temperature, precipitation, and soils affect the quantity of irrigation water required. In the Mother Lode Region such factors, particularly those pertaining to climate, may vary widely from service area to service area. The influence of climate on the use of water by irrigated crops is so great that climate itself is almost a measure of such use. However, sufficiently reliable data concerning the climatic factors affecting the use of water by irrigated crops are not available for evaluation purposes in all parts of the region. In studies for this bulletin, measured mean values of these climatic factors over a wide range of climatic conditions were related to the best available information concerning the use of water by irrigated crops under such conditions. As a result of these studies, a general method was developed whereby unit use of water factors for irrigated crops, at any elevation and latitude, could be derived from a graph, when the climatic factors of mean temperature and mean precipitation were known. In connection with the ensuing discussion of the development and use of this method, the following terms are defined:

Field Capacity—The quantity of water that a freely drained soil will retain against the force of gravity. Field capacity is expressed as a percentage, which is the weight of water retained divided by the dry weight of the soil, on a unit volume basis.

Sprinkler-irrigated Pear Orchard Near Placerville, El Dorado County

Courtesy of Armco Drainage and Metal Products, Inc., Calco Division

TABLE 18

ESTIMATED ULTIMATE LAND USE PATTERN, MOTHER LODE REGION

(In acres)

County and service area	Net irrigated areas	Gross urban areas	Other water service areas	Totals
Amador				
Ione	29,700	840	48,360	78,900
Jackson	8,400	1,780	69,520	79,700
Plymouth	8,100	300	33,500	41,900
Volcano	7,700	180	67,820	75,700
Subtotals, agricultural zone	53,900	3,100	219,200	276,200
National forest zone	80	0	103,920	104,000
Totals, county	53,980	3,100	323,120	380,200
Butte				
Bidwell	4,300	60	33,540	37,900
Big Bend	3,300	140	53,560	57,000
Buckeye	4,400	0	46,200	50,600
Chico	3,100	0	34,700	37,800
Deer Creek	4,100	40	43,660	47,800
Magalia	16,100	900	67,900	84,900
Wyandotte	27,600	5,300	84,300	117,200
Subtotals, agricultural zone	62,900	6,440	363,860	433,200
National forest zone	550	0	233,850	234,400
Totals, county	63,450	6,440	597,710	667,600
Calaveras				
Bear Mountain	15,500	160	78,040	93,700
Calaveras	13,400	720	140,580	154,700
Hogan	18,600	380	24,820	43,800
Mokelumne	12,700	440	69,360	82,500
Rock Creek	4,700	60	37,040	41,800
Stanislaus	10,700	980	72,820	84,500
West Point	2,700	120	29,080	31,900
Subtotals, agricultural zone	78,300	2,860	451,740	532,900
National forest zone	0	0	125,100	125,100
Totals, county	78,300	2,860	576,840	658,000
El Dorado				
Aukum	8,700	120	48,980	57,800
Georgetown	12,500	580	102,520	115,600
Latrobe	4,900	180	14,820	19,900
Placerville	42,000	3,280	192,720	238,000
Youngs	6,100	240	39,460	45,800
Subtotals, agricultural zone	74,200	4,400	398,500	477,100
National forest zone	1,070	0	511,430	512,500
Totals, county	75,270	4,400	909,930	989,600
Mariposa				
Baxter	3,200	0	35,100	38,300
Chowchilla	11,400	40	112,560	124,000
Hardin	5,600	160	119,740	125,500
Hornitos	11,500	80	91,620	103,200
Mariposa	3,700	260	108,840	112,800
White Rock	3,800	0	53,200	57,000
Subtotals, agricultural zone	39,200	540	521,060	560,800
National forest zone	70	0	370,330	370,400
Totals, county	39,270	540	891,390	931,200
Merced				
Baxter	3,500	320	15,680	19,500
Chowchilla	500	0	1,900	2,400
Hornitos	2,200	0	30,100	32,300
Subtotals, agricultural zone	6,200	320	47,680	54,200
National forest zone	------	------	------	------
Totals, county	6,200	320	47,680	54,200

County and service area	Net irrigated areas	Gross urban areas	Other water service areas	Totals
Nevada				
Grass Valley	42,300	5,840	171,060	219,200
Spaulding	2,800	0	37,500	40,300
Tyler	3,300	160	53,540	57,000
Subtotals, agricultural zone	48,400	6,000	262,100	316,500
National forest zone	90	0	197,210	197,300
Totals, county	48,490	6,000	459,310	513,800
Placer				
Colfax	12,700	4,080	72,920	89,700
Doty	40,100	960	54,140	95,200
Foresthill	13,100	460	69,710	83,300
Loomis	27,400	1,410	20,960	49,800
Subtotals, agricultural zone	93,300	6,940	217,760	318,000
National forest zone	630	0	373,970	374,600
Totals, county	93,930	6,940	591,730	692,600
Sacramento				
Carson	28,700	740	54,260	83,700
Laguna	36,700	0	50,200	86,900
Subtotals, agricultural zone	65,400	740	104,460	170,600
National forest zone	------	------	------	------
Totals, county	65,400	740	104,460	170,600
San Joaquin				
Arroyo Seco	13,400	0	14,100	27,500
Bear Creek	28,900	0	20,500	49,400
Subtotals, agricultural zone	42,300	0	34,600	76,900
National forest zone	------	------	------	------
Totals, county	42,300	0	34,600	76,900
Stanislaus				
Blanchard	1,200	0	6,400	7,600
Keystone	500	0	7,500	8,000
Rock Creek	1,900	0	11,200	13,100
Subtotals, agricultural zone	3,600	0	25,100	28,700
National forest zone	------	------	------	------
Totals, county	3,600	0	25,100	28,700
Tuolumne				
Blanchard	2,400	40	33,360	35,800
Groveland	9,000	360	49,640	59,000
Keystone	9,500	120	67,380	77,000
Lyons	5,300	1,280	51,620	58,200
Phoenix	14,500	2,260	66,540	83,300
Subtotals, agricultural zone	40,700	4,060	268,540	313,300
National forest zone	1,440	0	1,141,260	1,142,700
Totals, county	42,140	4,060	1,409,800	1,456,000
Yuba				
Browns Valley	13,700	140	35,560	49,400
Challenge	20,600	300	82,100	103,000
Smartville	4,700	80	13,920	18,700
Strawberry	2,600	0	14,100	16,700
Subtotals, agricultural zone	41,600	520	145,680	187,800
National forest zone	190	0	43,610	43,800
Totals, county	41,790	520	189,290	231,600
APPROXIMATE TOTALS, AGRICULTURAL ZONE	650,000	36,000	3,060,000	3,746,000
APPROXIMATE TOTALS, NATIONAL FOREST ZONE	4,000	0	3,101,000	3,105,000
APPROXIMATE TOTALS, REGION	654,000	36,000	6,161,000	6,851,000

Available Soil Moisture—The quantity of water in the soil that is readily available for plant use, expressed as depth of water in inches per foot of soil depth.

The general method followed for evaluating unit consumptive use of applied water by irrigated crops is summarized as follows:

1. Mean values of monthly and seasonal precipitation and temperature were determined for 34 selected United States Weather Bureau stations scattered throughout the Mother Lode Region and adjacent valley floor areas. The base stations selected reflect climatic conditions over the entire range of elevation and latitude of the agricultural zone. All of the stations possess records of long duration, the average period being 58 years.

2. Mean unit values of the consumptive use of applied water by irrigated crops during the growing season were computed for each of the 34 base stations by means of the Blaney-Criddle method. This method was developed by Harry F. Blaney and Wayne D. Criddle of the Soil Conservation Service, United States Department of Agriculture, in their reports entitled "A Method of Estimating Water Requirements in Irrigated Areas From Climatological Data," dated December, 1947, and "Determining Water Requirements in Irrigated Areas From Climatological and Irrigation Data," dated August, 1950. According to the Blaney-Criddle procedure, the total unit consumptive use of water by irrigated crops during each month of the growing season is equal to the product of available heat and an appropriate coefficient of consumption, where: (a) available heat is the product of the average monthly temperature and the monthly percentage of total annual daylight hours, and (b) the coefficient of consumption is an empirical factor determined for individual crops on the basis of field measurements and studies. The factor of daylight hours is a function of latitude, and its value varies no more than two per cent over the complete range of latitude in the Mother Lodge Region. Data regarding daylight hours are available in publications of the United States Weather Bureau.

3. Mean unit values of seasonal consumptive use of applied water were computed as the difference between total consumptive use during the growing season and effective precipitation, where effective precipitation consists of mean precipitation during the growing season plus one-half the available soil moisture. It was assumed that, at the start of the growing season, soils would be at field capacity as a result of winter rains, and that one-half the available soil moisture would be consumed by the crop during the growing season. Data concerning available moisture in typical soils of the region were obtained from Dr. F. J. Veihmeyer of the University of California, College of Agriculture, at Davis. Tests of Aiken, Holland, Hugo, Corning, and Redding soils showed an average available moisture content of about 1.5 inches per foot of soil depth. It was assumed that the average depth of soil would be two feet. On this basis, the crops would consume 1.5 inches of soil moisture during the growing season.

4. Weighted mean values of unit consumptive use of applied water were determined at the 34 localities, and these were plotted as the third variable on a graph with recorded mean seasonal precipitation as ordinates and with recorded mean seasonal temperature as abscissas. Straight line parameters were drawn through the plotted points to represent changes of one inch in depth of mean seasonal consumptive use of applied water. The graph is shown on Plate 15, entitled "General Relation Between Climate and Unit Use of Applied Irrigation Water."

The use of Plate 15 to derive values for unit consumptive use of applied irrigation water in any part of the region required measurement of mean seasonal depth of precipitation and mean seasonal temperature for that area. The former quantity was obtained from Plate 4, but data regarding mean seasonal temperatures were not readily available except for specific points. Since temperature varies generally with elevation, the relation between these factors permitted direct use of the average elevation of irrigable lands as depth of precipitation and mean seasonal temperature To establish the general relation between elevation and temperature, the measured and recorded values of the two variables, at the 34 United States Weather Bureau stations previously described, were plotted on a graph, and a mean curve was drawn through the somewhat scattered points. Tabulated values from this curve are given in Table 19.

TABLE 19

RELATION OF ELEVATION TO MEAN SEASONAL TEMPERATURE, MOTHER LODE REGION

Elevation, in feet	Mean annual temperature, in degrees F.
100	61.1
500	62.2
1,000	61.7
1,500	60.5
2,000	58.8
2,500	56.9
3,000	54.9
3,500	53.2
4,000	51.9
4,500	50.8

The derivation of the unit use of water factor for any group of irrigable lands in any part of the Mother Lode Region was accomplished as follows:

1. Mean seasonal precipitation on the irrigable land was measured from Plate 4.

2. The average elevation of the irrigable land was measured from topographic maps.

3. With average elevation known, mean seasonal temperature was obtained from Table 19.

4. With mean seasonal temperature and mean seasonal precipitation known, unit use of applied irrigation water was obtained from the graph on Plate 15.

On the basis of the above procedure, unit use of water factors were computed for all service areas in the Mother Lode Region. These factors, together with the climatic and physical data from which they were derived, are presented in Table 20. The unit use of water factor listed for any service area is an average value. Obviously, the value of the factor would vary within the service area as elevation and precipitation vary. In computing total water requirements in any service area, however, the result obtained by using the average value of the unit use of water factor would be the same as if every parcel of irrigable land were considered separately.

Since the irrigated and potentially irrigable areas in the national forest zone are insignificant in extent, no studies were made regarding the unit use of water by irrigated crops in that zone. Unit use of water factors applicable to irrigated areas within the national forest zone were taken to be, in each county, equal to the smallest factor derived for service areas in the agricultural zone.

Although the graphic method for obtaining unit values of consumptive use of applied irrigation water is based on rational procedures and on the best available information, a field check of its validity was desirable. Data available from records of existing water service agencies were not sufficiently detailed to permit the determination of actual values of consumptive use of applied water. Such determinations require accurate and complete measurement of inflow to and outflow from the area being investigated. The measurements must include precipitation on the irrigated lands, diversions of water by canals and ditches, and all outflow, or drainage from the irrigated area.

TABLE 20

ESTIMATED MEAN SEASONAL UNIT CONSUMPTIVE USE OF APPLIED IRRIGATION WATER AND RELATED CLIMATIC FACTORS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

County and service area	Average elevation of irrigable land, in feet	Mean seasonal temperature, in degrees F.	Mean seasonal precipitation on irrigable land, in inches of depth	Mean seasonal unit consumptive use of applied water, in inches of depth
Amador				
Ione	400	62.1	20	22.7
Jackson	1,300	61.1	25	21.5
Plymouth	1,400	60.8	26	21.3
Volcano	2,700	56.0	30	19.0
Butte				
Bidwell	3,200	54.2	66	13.7
Big Bend	1,300	61.1	45	18.6
Buckeye	2,500	56.9	55	16.0
Chico	2,300	57.6	58	15.7
Deer Creek	2,900	55.3	48	16.3
Magalia	2,500	56.9	70	14.1
Wyandotte	1,000	61.7	35	20.2
Calaveras				
Bear Mountain	1,000	61.7	27	21.4
Calaveras	2,000	58.8	33	19.6
Hogan	300	61.9	19	22.8
Mokelumne	1,500	60.5	27	21.0
Rock Creek	700	62.1	21	22.6
Stanislaus	1,700	59.8	30	20.3
West Point	2,700	56.0	37	18.0
El Dorado				
Aukum	2,300	57.7	34	19.0
Georgetown	1,900	59.2	39	18.8
Latrobe	400	62.1	26	21.6
Placerville	2,000	58.8	35	19.4
Youngs	3,000	54.9	39	17.4
Mariposa				
Baxter	1,100	61.6	25	21.7
Chowchilla	2,400	57.3	34	18.9
Hardin	3,000	54.9	38	17.5
Hornitos	1,000	61.7	18	23.0
Mariposa	2,200	58.1	30	19.8
White Rock	700	62.1	15	23.6
Merced				
Baxter	300	61.9	16	23.4
Chowchilla	400	62.1	13	23.9
Hornitos	500	62.2	14	23.8

County and service area	Average elevation of irrigable land, in feet	Mean seasonal temperature, in degrees F.	Mean seasonal precipitation on irrigable land, in inches of depth	Mean seasonal unit consumptive use of applied water, in inches of depth
Nevada				
Grass Valley	2,200	58.1	48	17.3
Spaulding	3,400	53.5	57	14.5
Tyler	2,400	57.3	44	17.5
Placer				
Colfax	2,000	58.8	37	19.0
Doty	4,000	62.1	26	21.6
Foresthill	3,200	54.2	50	15.7
Loomis	400	62.1	25	21.8
Sacramento				
Carson	300	61.9	19	22.8
Laguna	100	61.1	18	22.7
San Joaquin				
Arroyo Seco	200	61.7	17	23.1
Bear Creek	200	61.7	18	23.0
Stanislaus				
Blanchard	400	62.1	17	23.2
Keystone	400	62.1	19	23.0
Rock Creek	300	61.9	17	23.2
Tuolumne				
Blanchard	1,100	61.6	21	22.3
Groveland	2,800	55.6	33	18.4
Keystone	1,000	61.7	24	21.9
Lyons	2,800	55.6	35	18.2
Phoenix	1,700	59.8	31	20.2
Yuba				
Browns Valley	300	61.9	27	21.4
Challenge	2,000	58.8	55	16.6
Smartville	4,000	62.1	26	21.7
Strawberry	3,400	53.5	75	12.8

In order to test the validity of the graphic method developed in this investigation for the computation of unit use of applied water, complete and detailed inflow-outflow measurements were conducted on four small watersheds in Placer County in connection with the State Water Resources Board investigation covering Placer County. The watersheds are located in the highly developed orchard area in the foothills of Placer County, and include a portion of Eden Valley, Penryn Valley, the upper portion of the Sailor Ravine watershed, and the Mormon Creek watershed. Areas of the watersheds vary from 113 to 3,225 acres, and the average elevations of the watersheds range from about 500 to about 2,300 feet above sea level. Locations of the watersheds are indicated on Plate 13.

Field measurements on the watersheds were conducted throughout the irrigation season of 1951. The water supply consisted of precipitation and of diversions from canals of the Pacific Gas and Electric Company and Nevada Irrigation District. Records of inflow and outflow were obtained from measurements at supply and distribution boxes, and by means of continuous water stage recorders installed at proper points in drainage channels. Precipitation data were obtained from United States Weather Bureau records at Auburn, Colfax, and Rocklin. Of a total irrigated area of about 5,400 acres in the four watersheds, approximately 3,300 acres or 61 per cent were orchard, about 1,200 acres or 22 per cent were water-consuming native vegetation, and the remaining 900 acres or 17 per cent were pasture and vineyard. The results of the studies are shown in Table 21, which also shows, for comparison, the estimated unit values of consumptive use of applied water for the 1951 land use pattern and climatological conditions, and the estimated mean unit values of consumptive use of applied water under ultimate conditions, derived by the graphic method previously described. Data obtained in connection with the studies are given in Appendix D.

Table 21 indicates that unit consumptive use of applied water as computed from the 1951 land use pattern and climatological conditions agrees fairly closely with the measured values in all of the watersheds except Eden Valley. In this watershed, the smallest of the four, the computed value is considerably higher. The table also indicates that the 1951 computed unit values of consumptive use of applied water agree reasonably with values given by the graphic method. The small variation reflects differences in climatological factors between 1951 conditions and mean conditions as well as differences between present and assumed ultimate crop practices. It is considered, therefore, that the results of the test plot studies support the general validity of the graphic method.

Water for Urban and Miscellaneous Purposes. Unit use of water factors applicable to nonirrigated types of land use were estimated according to the following procedures. It will be noted that in some instances definite quantities of water use were estimated in lieu of unit use of water factors.

1. The delivery of water in urban areas was estimated to be 150 gallons per capita per day for present conditions, and 165 gallons per capita per day for ultimate conditions. The value for present conditions was estimated on the basis of available data concerning such use of water in the principal urban areas of the Mother Lode Region and adjoining areas, and represents water actually delivered to consumers, not the gross quantity diverted. It was further estimated that under both present and ultimate conditions 50 per cent of the delivered water is consumptively used, and the remainder becomes available for re-use.

2. Unit values of water use for all lands listed in Table 22 under the classification "Other Water Service Areas" were based on the assumptions that the use of water in such areas will be primarily of a residential nature, that the average population density will be four persons per square mile, that the delivery of water will amount to 70 gallons per capita per day, and that there will be no re-use of any portion of the delivered water. In the national forest zone, however, it was considered that this type of water use will occur, on the average, only during a total period of three months of the year.

3. In order to make allowance for the use of water for domestic and stockwatering purposes in irrigated

TABLE 21

UNIT VALUES OF CONSUMPTIVE USE OF APPLIED WATER IN SELECTED FOOTHILL AREAS OF PLACER COUNTY

Area	Irrigated area, in acres	Average elevation, in feet	Seasonal consumptive use of applied water, in inches of depth		
			1951, measured	1951, computed	Estimated mean for ultimate conditions
Eden Valley	113	2,300	15.5	20.8	17.5
Penryn Valley	2,225	500	24.4	22.1	21.8
Sailor Ravine	209	1,200	23.4	22.0	21.2
Shirland Ditch	685	1,100	19.5	19.4	21.0

TABLE 22

ESTIMATED PRESENT MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER, MOTHER LODE REGION

(In acre-feet)

County and service area	Irrigated areas	Urban areas	Other water service areas	Totals
Amador				
Ione	1,570	180	80	1,830
Jackson	0	370	10	380
Plymouth	70	60	30	160
Volcano	50	40	10	100
Subtotals, agricultural zone	1,690	650	130	2,470
National forest zone	0	0	80	80
Totals, county	1,690	650	210	2,550
Butte				
Bidwell	0	20	0	20
Big Bend	60	30	10	100
Buckeye	350	0	10	360
Chico	30	0	10	40
Deer Creek	0	10	10	20
Magalia	2,180	190	50	2,420
Wyandotte	6,740	1,120	80	7,940
Subtotals, agricultural zone	9,360	1,370	170	10,900
National forest zone	160	0	230	390
Totals, county	9,520	1,370	400	11,290
Calaveras				
Bear Mountain	0	40	20	60
Calaveras	370	150	10	530
Hogan	680	80	40	800
Mokelumne	440	90	10	540
Rock Creek	0	20	10	30
Stanislaus	1,370	200	30	1,600
West Point	150	30	10	190
Subtotals, agricultural zone	3,010	610	130	3,750
National forest zone	0	0	160	160
Totals, county	3,010	610	290	3,910
El Dorado				
Aukum	0	30	10	40
Georgetown	2,480	120	30	2,630
Latrobe	0	40	10	50
Placerville	9,720	690	130	10,540
Youngs	0	50	10	60
Subtotals, agricultural zone	12,200	930	190	13,320
National forest zone	320	0	640	960
Totals, county	12,520	930	830	14,280
Mariposa				
Baxter	0	0	0	0
Chowchilla	440	10	10	460
Hardin	30	40	10	80
Hornitos	0	20	10	30
Mariposa	30	50	10	90
White Rock	100	0	10	110
Subtotals, agricultural zone	600	120	50	770
National forest zone	100	0	100	200
Totals, county	700	120	150	970
Merced				
Baxter	760	60	10	830
Chowchilla	0	0	0	0
Hornitos	0	0	0	0
Subtotals, agricultural zone	760	60	10	830
National forest zone	0	0	0	0
Totals, county	760	60	10	830

County and service area	Irrigated areas	Urban areas	Other water service areas	Totals
Nevada				
Grass Valley	9,290	1,220	100	10,610
Spaulding	0	0	10	10
Tyler	160	30	10	200
Subtotals, agricultural zone	9,450	1,250	120	10,820
National forest zone	0	0	2,540	2,540
Totals, county	9,450	1,250	2,660	13,360
Placer				
Colfax	5,850	850	70	6,770
Doty	22,720	200	260	23,180
Foresthill	10	100	10	120
Loomis	22,420	300	250	22,970
Subtotals, agricultural zone	51,000	1,450	590	53,040
National forest zone	30	0	840	870
Totals, county	51,030	1,450	1,430	53,910
Sacramento				
Carson	4,410	150	60	4,620
Laguna	1,690	0	70	1,760
Subtotals, agricultural zone	6,100	150	130	6,380
National forest zone	0	0	0	0
Totals, county	6,100	150	130	6,380
San Joaquin				
Arroyo Seco	1,080	0	80	1,160
Bear Creek	1,130	0	170	1,300
Subtotals, agricultural zone	2,210	0	250	2,460
National forest zone	0	0	0	0
Totals, county	2,210	0	250	2,460
Stanislaus				
Blanchard	0	0	0	0
Keystone	40	0	10	50
Rock Creek	0	0	10	10
Subtotals, agricultural zone	40	0	20	60
National forest zone	0	0	0	0
Totals, county	40	0	20	60
Tuolumne				
Blanchard	0	10	10	20
Groveland	0	80	10	90
Keystone	40	20	10	70
Lyons	1,450	270	20	1,740
Phoenix	710	470	30	1,210
Subtotals, agricultural zone	2,200	850	80	3,130
National forest zone	140	0	480	620
Totals, county	2,340	850	560	3,750
Yuba				
Browns Valley	6,480	30	70	6,580
Challenge	1,080	60	10	1,150
Smartville	450	20	10	480
Strawberry	0	0	10	10
Subtotals, agricultural zone	8,010	110	100	8,220
National forest zone	140	0	1,660	1,800
Totals, county	8,150	110	1,760	10,020
APPROXIMATE TOTALS, AGRICULTURAL ZONE	106,600	7,600	2,000	116,200
APPROXIMATE TOTALS, NATIONAL FOREST ZONE	900	0	6,700	7,600
APPROXIMATE TOTALS, REGION	107,500	7,600	8,700	123,800

areas, a seasonal unit consumptive use of applied water factor of one-half foot of depth was adopted for farmstead lots. It was assumed that the present extent of such areas is equal to three per cent of the present cultivated area, and that the ultimate extent will be equal to five per cent of the gross irrigable area. These allowances apply only to the agricultural zone.

4. Estimates of present and ultimate requirements for water for miscellaneous nonagricultural purposes in the national forest zone were furnished by the United States Forest Service. These estimates are included in subsequent tabulations of water requirements. The estimates cover use of water by tourist and recreational establishments, by commercial and industrial enterprises, and by other installations. They are generally based on delivery records, and assume no re-use of any portion of the delivered water. The quantities of water presented in the estimates are relatively very small.

Present Consumptive Use of Applied Water

Estimates of present consumptive use of applied water in the Mother Lode Region were generally derived by applying the foregoing unit use of water factors to the appropriate acreages of the present land use pattern. The estimates are presented in Table 22.

Ultimate Consumptive Use of Applied Water

The total seasonal consumptive use of applied water in the various service areas of the Mother Lode Region was estimated as it would be under mean conditions of climate and according to the estimated ultimate land use pattern previously presented. The estimates were derived by multiplying the areas of the various types in the ultimate pattern of land use by the corresponding unit use of water factors. The estimates of ultimate consumptive use of applied water are presented in Table 23. It should be emphasized that these estimates do not represent a forecast or a prediction of the actual quantities of water which may be eventually consumed in the region. They represent only an evaluation of the maximum quantities. It is entirely possible that actual consumption of applied water in many parts of the region may never approach these maximum quantities. It should be pointed out also that consumption of applied water in the national forest zone and in habitable areas of the agricultural zone is not considered to be a potential draft on future project water supplies. It is believed that the nature of these types of water utilization is such that small-scale and individual development of springs, wells, and local streams is and will continue to be the most satisfactory means of providing for such utilization.

FACTORS OF WATER DEMAND

In the planning of water supply projects, it is necessary to make allowances for all of the factors which affect demands for water, in order that the proper capacities of reservoirs and distribution systems can be determined. The ensuing discussion of the factors affecting demands for water is concerned primarily with irrigation demand, since in the Mother Lode Region the ultimate utilization of water for irrigation purposes is estimated to account for more than 90 per cent of the total utilization for all consumptive purposes. The principles involved, however, apply to other types of demand as well.

Application of Water

The term "Applied Water," as used in this bulletin, refers to that water other than precipitation which is delivered to a farmer's headgate in the case of irrigation use, or is delivered to an individual's meter in the case of urban use, or its equivalent.

In the Mother Lode Region, water for irrigation is diverted from streams, canals, and conduits, generally by means of miner's inch boxes. The miner's inch box is a special form of free-flowing orifice. The diversion is made on a continuous flow basis for about 150 days, and the water is commonly measured in miner's inches. A miner's inch is the quantity of water which discharges through a square inch of opening under a prescribed head. The number of miner's inches is equal to the area of the opening in square inches. The number of miner's inches per acre is used as a measure of duty of water. The general practice is to buy one-half miner's inch of water per acre of pasture, whether irrigated by sprinkler or flooding. This amounts to an application of about 45 inches depth of water during the season from May through September. On orchard land, irrigation practice is varied, with applications ranging from one miner's inch for six acres to one miner's inch per acre. Generally, less water is applied with furrow irrigation, because even a minimum rate of application results in a high rate of runoff. Irrigation practice and crop production are improved by use of sprinklers, which permit better control and application of greater amounts of water. The use of cover crops on orchard lands has also resulted in increased application of water to these lands.

Estimates were made of the total amount of water which would be applied to lands in the Mother Lode Region under ultimate development. These estimates were for the most part based on results of plot studies conducted during the 1949-50 season in the foothill area in connection with the Placer County Investigation. Results of these plot studies of water

TABLE 23

ESTIMATED ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER, MOTHER LODE REGION

(In acre-feet)

County and service area	Irrigated areas	Urban areas	Other water service areas	Totals
Amador				
Ione	56,200	800	1,000	58,000
Jackson	15,000	1,600	300	16,900
Plymouth	14,400	300	300	15,000
Volcano	12,200	200	300	12,700
Subtotals, agricultural zone	97,800	2,900	1,900	102,600
National forest zone	200	0	300	500
Totals, county	98,000	2,900	2,200	103,100
Butte				
Bidwell	4,900	100	200	5,200
Big Bend	5,100	200	200	5,500
Buckeye	5,800	0	200	6,000
Chico	4,000	0	200	4,200
Deer Creek	5,600	100	200	5,900
Magalia	18,000	800	600	20,200
Wyandotte	46,600	4,900	900	52,400
Subtotals, agricultural zone	90,800	6,100	2,500	99,400
National forest zone	600	0	1,100	1,700
Totals, county	91,400	6,100	3,600	101,100
Calaveras				
Bear Mountain	27,700	200	600	28,500
Calaveras	21,900	700	500	23,100
Hogan	35,400	300	600	36,300
Mokelumne	22,200	400	500	23,100
Rock Creek	8,800	100	200	9,100
Stanislaus	18,100	900	400	19,400
West Point	4,100	200	200	4,500
Subtotals, agricultural zone	138,200	2,800	3,000	144,000
National forest zone	0	0	300	300
Totals, county	138,200	2,800	3,300	144,300
El Dorado				
Aukum	13,800	200	300	14,300
Georgetown	19,600	500	500	20,600
Latrobe	8,900	200	200	9,300
Placerville	67,400	3,000	1,400	71,800
Youngs	8,800	300	300	9,400
Subtotals, agricultural zone	118,500	4,200	2,700	125,400
National forest zone	1,600	0	1,700	3,300
Totals, county	120,100	4,200	4,400	128,700
Mariposa				
Baxter	5,800	0	200	6,000
Chowchilla	17,900	100	500	18,500
Hardin	8,200	100	300	8,600
Hornitos	22,000	100	500	22,600
Mariposa	6,100	200	200	6,500
White Rock	7,400	0	200	7,600
Subtotals, agricultural zone	67,400	500	1,900	69,800
National forest zone	200	0	300	500
Totals, county	67,600	500	2,200	70,300
Merced				
Baxter	6,800	300	200	7,300
Chowchilla	1,000	0	100	1,100
Hornitos	4,300	0	100	4,400
Subtotals, agricultural zone	12,100	300	400	12,800
National forest zone	----	----	----	----
Totals, county	12,100	300	400	12,800
Nevada				
Grass Valley	60,900	5,400	1,400	67,700
Spaulding	3,400	0	200	3,600
Tyler	4,800	200	200	5,200
Subtotals, agricultural zone	69,100	5,600	1,800	76,500
National forest zone	200	0	4,800	5,000
Totals, county	69,300	5,600	6,600	81,500
Placer				
Colfax	20,100	3,800	500	24,400
Doty	72,400	900	1,300	74,600
Foresthill	17,100	400	500	18,000
Loomis	49,800	1,400	900	52,100
Subtotals, agricultural zone	159,400	6,500	3,200	169,100
National forest zone	900	0	2,400	3,300
Totals, county	160,300	6,500	5,600	172,400
Sacramento				
Carson	54,500	700	1,000	56,200
Laguna	69,400	0	1,300	70,700
Subtotals, agricultural zone	123,900	700	2,300	126,900
National forest zone	----	----	----	----
Totals, county	123,900	700	2,300	126,900
San Joaquin				
Arroyo Seco	25,800	0	500	26,300
Bear Creek	55,300	0	1,000	56,300
Subtotals, agricultural zone	81,100	0	1,500	82,600
National forest zone	----	----	----	----
Totals, county	81,100	0	1,500	82,600
Stanislaus				
Blanchard	2,300	0	100	2,400
Keystone	1,000	0	100	1,100
Rock Creek	3,700	0	100	3,800
Subtotals, agricultural zone	7,000	0	300	7,300
National forest zone	----	----	----	----
Totals, county	7,000	0	300	7,300
Tuolumne				
Blanchard	4,500	100	100	4,700
Groveland	13,800	300	300	14,400
Keystone	17,400	200	400	18,000
Lyons	8,000	1,200	200	9,400
Phoenix	24,400	2,100	500	27,000
Subtotals, agricultural zone	68,100	3,900	1,500	73,500
National forest zone	2,200	0	1,600	3,800
Totals, county	70,300	3,900	3,100	77,300
Yuba				
Browns Valley	24,500	200	500	25,200
Challenge	28,600	300	700	29,600
Smartville	8,500	100	200	8,800
Strawberry	2,800	0	100	2,900
Subtotals, agricultural zone	64,400	600	1,500	66,500
National forest zone	200	0	4,500	4,700
Totals, county	64,600	600	6,000	71,200
TOTALS, AGRICULTURAL ZONE	1,098,000	34,000	24,000	1,156,000
TOTALS, NATIONAL FOREST ZONE	6,000	0	17,000	23,000
TOTALS, REGION	1,104,000	34,000	41,000	1,179,000

diverted from canals in the foothill area are summarized in the following tabulation.

Crop	Number of plots	Weighted average unit application of water Inches of depth	Feet of depth
Orchard	6	47	3.8
Orchard and cover crop	1	49	4.1
Pasture	3	52	4.3
Pears	1	30	2.5

Application of water to irrigated lands in the agricultural zone was computed by multiplying net irrigable areas by corresponding application of water factors obtained as described above. Application of water in urban areas was computed by multiplying estimated ultimate urban populations by a water factor of 165 gallons per day. The application of water in other water service areas of the agricultural zone consisted of an allowance of 70 gallons per day per capita for an estimated population of four persons per square mile. The summary of these estimates is given in Table 24.

Irrigation Efficiency

Irrigation efficiency, usually expressed as a percentage, is the ratio between the quantity of applied water consumed by the irrigated crop and the quantity of water applied to the cropped land. Due to unavoidable application losses, irrigation efficiency

TABLE 24

ESTIMATED ULTIMATE SEASONAL APPLICATION OF WATER BY SERVICE AREAS IN THE AGRICULTURAL ZONE, MOTHER LODE REGION

(In acre-feet)

County and service area	Application of water
Amador	
Ione	96,800
Jackson	33,800
Plymouth	30,000
Volcano	25,400
Subtotal	186,000
Butte	
Bidwell	10,400
Big Bend	11,000
Buckeye	12,000
Chico	7,000
Deer Creek	11,800
Magalia	33,700
Wyandotte	104,800
Subtotal	190,700
Calaveras	
Bear Mountain	57,000
Calaveras	46,200
Hogan	72,600
Mokelumne	46,200
Rock Creek	18,200
Stanislaus	38,800
West Point	9,000
Subtotal	288,000
El Dorado	
Aukum	28,600
Georgetown	34,300
Latrobe	15,500
Placerville	119,700
Youngs	18,800
Subtotal	216,900
Mariposa	
Baxter	12,000
Chowchilla	37,000
Hardin	17,200
Hornitos	45,200
Mariposa	13,000
White Rock	15,200
Subtotal	139,600
Merced	
Baxter	14,600
Chowchilla	2,200
Hornitos	8,800
Subtotal	25,600
Nevada	
Grass Valley	135,400
Spaulding	7,200
Tyler	10,400
Subtotal	153,000
Placer	
Colfax	40,700
Doty	149,200
Foresthill	25,700
Loomis	86,900
Subtotal	302,500
Sacramento	
Carson	93,700
Laguna	117,800
Subtotal	211,500
San Joaquin	
Arroyo Seco	52,600
Bear Creek	66,200
Subtotal	118,800
Stanislaus	
Blanchard	4,800
Keystone	2,200
Rock Creek	7,600
Subtotal	14,600
Tuolumne	
Blanchard	9,400
Groveland	28,800
Keystone	36,000
Lyons	18,800
Phoenix	54,000
Subtotal	147,000
Yuba	
Browns Valley	50,400
Challenge	59,200
Smartville	17,600
Strawberry	5,800
Subtotal	133,000
APPROXIMATE TOTAL	2,127,000

is always less than unity. Irrigation efficiencies vary widely in different localities. In areas where water supplies are plentiful and costs are low, irrigation efficiency is generally low. The opposite condition usually prevails in areas where water supplies are limited and costs are high, or where over-application may result in waterlogging. Irrigation efficiencies in California range from about 20 per cent for poor practice to as high as 80 per cent for the best practice. A reasonable value obtainable with the use of sprinkler irrigation systems is 75 per cent. By using ordinary surface methods of irrigating, a reasonable efficiency is about 50 per cent.

Little information is available regarding current irrigation practice in the Mother Lode Region. There are few organized agencies furnishing irrigation water and such records as are available do not permit accurate calculations of irrigation efficiencies. Efficiencies were calculated, however, for the Placer County test plots studied for the purpose of determining consumptive use of applied water. Irrigated areas and calculated irrigation efficiencies for these test plots are shown in the following tabulation.

Test plot	*Irrigated area, in acres*	*Irrigation efficiency, in per cent*
Eden Valley	113	51
Penryn Valley	3,225	56
Sailor Ravine	209	55
Shirland Ditch	685	55

The efficiencies indicated in the tabulation are area efficiencies. Actual farm irrigation efficiencies would be lower, since, on these test plots, return flows from irrigated lands were recovered and re-used to some degree within the test plots. The irrigated areas of the Eden Valley and Sailor Ravine plots are sufficiently small, however, to indicate farm irrigation efficiencies. The close agreement of the efficiencies of the larger plots with those of the smaller indicates that recovery of return flows in the larger areas was not substantial and that the computed efficiencies are essentially farm irrigation efficiencies. While the efficiencies listed in the tabulation do not necessarily apply to other irrigated areas, it is considered that they represent reasonable values for present irrigation practice in the mountainous areas. It is believed that increasing requirements for water and increasing costs of developing new water supplies will eventually result in irrigation efficiencies substantially higher than those obtained today.

Conveyance Losses

Loss of water by seepage from canals between points of storage and points of use is a major factor affecting the design capacities of reservoirs and distribution systems. Loss of water from unlined canals is generally more than that from lined canals. Canal losses in mountainous areas are sometimes recovered in other canals at lower elevations, but more often the water lost is consumed by native vegetation between canal routes and natural channels. In valley floor areas seepage from unlined canals often accrues to ground water and is recovered by pumping, but this possibility does not generally exist in the mountainous areas. Due to the necessity for allowing for conveyance losses, demands for water at the reservoir must be larger than the demand at the service area. The capacities of reservoirs and conveyance systems must be sufficient to cover such losses so that the quantity of water reaching the service area will satisfy the demand at that point. Seepage rates from unlined canals are affected by the permeability of the soil, the velocity and depth of flow, the silt content of the water, and other factors. Losses from lined canals are controlled primarily by the type of lining. Seepage rates are usually expressed in cubic feet of water per day per square foot of wetted area, but they are often described as a percentage per mile of the total flow in the canal. Seepage from unlined canals may vary from less than one per cent to more than ten per cent per mile. Losses from lined canals are only a small fraction of those from unlined canals. The actual losses, depending on the type of lining, may be as low as one-tenth of one per cent per mile. In many instances the value of the water saved by the lining of canals, together with related benefits such as reduced maintenance costs and reduced capacities of hydraulic structures, will more than offset the additional expense of lining. Canals may be successfully lined with a wide variety of materials, including concrete, gunite, asphalt membrane, asphaltic concrete, bentonite, and compacted earth, the most economical choice depending on such factors as the size of canal, availability of materials, and the problems presented by the particular job under consideration.

In computing demands for water at points of storage or diversion, the necessary allowances for conveyance losses can be made realistically only when the locations of proposed reservoirs, diversions, and canals are established and the desirability of lining canals can be considered on the basis of costs and benefits. Thus, the evaluation of conveyance losses is properly a part of project planning. When maximum development and utilization of available water supplies is the objective of project planning, the lining of canals to reduce losses of water may be a fundamental criterion.

Return Flow

In the previous discussion of irrigation efficiency, it was shown that the average quantity of water applied to the irrigated lands in the Placer County test plots was almost twice the quantity actually consumed by the irrigated crops. The unconsumed water constitutes return flow to the extent that it reaches surface channels or ground water basins from which it may be rediverted. Return flow is an important source of water supply. In many instances, portions of the return flow from an irrigated area may be recovered and re-used within the area itself. In any event, however, such return flow as cannot be recovered within the area where it originates accrues to downstream areas as a source of water supply when properly developed. Obviously, the draft on stored water is reduced to the extent that return flows can be utilized. Due to the utilization of return flow, the efficiency in use of water in an entire service area is substantially larger than that of individual farms in the area.

The magnitude of usable return flow from irrigated areas is influenced by such factors as irrigation efficiencies, topography, patterns of irrigable land, locations of canals, and other conditions. In the Mother Lode Region, topography is generally favorable to the rapid accumulation of return flows in surface channels, but no significant ground water basins exist from which water percolating below the root zone may be recovered. A very important factor is the pattern of irrigable land in the region. With some exceptions, the lands occur generally in noncontiguous parcels of limited extent separated by substantial areas of nonirrigable land. This condition permits the consumption of appreciable quantities of return flow from irrigated lands by native vegetation between the limits of irrigated tracts and natural watercourses, and reduces the quantities of return flow which may be recovered and put to use.

The planning of future water supply projects to serve the Mother Lode Region will require evaluations of usable return flows with respect to their effect on the capacities of hydraulic structures as well as their effect on stream depletion. Due to the wide variations in the factors influencing return flows in different service areas, no arbitrary evaluation applicable to all areas can be given. Since the layout of distribution systems has a substantial influence on recoverable quantities of return flow, the situation in each service area must be examined during project planning stages.

Monthly Demands for Water

Rates and times of occurrence of demands for water affect the investigation, design, and operation of water supply projects. Schedules of irrigation demands are imposed primarily by the type of development and land use practice, and by such climatic factors as precipitation and length of growing season. In the Mother Lode Region the climatic factors vary substantially with elevation, but only to a slight extent with latitude. For this reason, rates of demands for irrigation water in any given elevation zone are about the same in all parts of the region. Virtually all of the total seasonal irrigation requirement occurs during the April-September period. At higher elevations in the region the growing season is shorter, and substantial delivery of irrigation water begins about a month later than at low elevations. Irrigation demands vary considerably from month to month, the demand in July and August being as much as 12 times the demand in April.

Precise data regarding actual irrigation demand schedules are not available for all parts of the region. The available data are adequate, however, for the purpose of establishing reasonable demand schedules for project planning purposes. Table 25 presents irrigation demand schedules based on the experience of two irrigation districts within the region and two districts adjoining the western boundary of the region. The schedule of the Nevada Irrigation District was computed from canal discharge records. The indicated demands during the winter months are not significant so far as irrigation demand is concerned, since lands are not irrigated during these months. Otherwise, the schedule corresponds well with that of the Oroville-Wyandotte Irrigation District, the latter schedule being computed from records of water sales. The data shown for the Oakdale and South San Joaquin Irrigation Districts were furnished by those agencies. The districts are located in San Joaquin and Stanislaus Counties adjoining the western limit of the Mother Lode Region.

TABLE 25

MONTHLY IRRIGATION DEMAND SCHEDULES OF IRRIGATION DISTRICTS IN OR ADJOINING THE MOTHER LODE REGION

(In per cent of seasonal demand)

Month	Oroville-Wyandotte Irrigation District	Nevada Irrigation District*	Oakdale and South San Joaquin Irrigation Districts
January	0	2	0
February	0	1	0
March	0	1	2
April	3	3	10
May	10	12	16
June	16	16	19
July	20	20	19
August	22	19	16
September	19	15	12
October	9	7	5
November	1	2	1
December	0	2	0
TOTALS	100	100	100

* Placer County unit of Nevada Irrigation District.

Urban demands for water are fairly steady throughout the year, although they vary somewhat from month to month. These demands vary to a greater degree in the small urban centers in mountainous areas than in large metropolitan areas, probably because such demands cover considerable irrigation of small gardens and orchards within the urban districts. When a reservoir is operated to satisfy both urban and irrigation demands, the composite demand schedule is little different from the irrigation schedule alone since urban demands are only a very small fraction of irrigation demands. A typical urban demand schedule, based on experience of the El Dorado Irrigation District, is listed in Table 26.

TABLE 26

MONTHLY DISTRIBUTION OF MUNICIPAL AND DOMESTIC DEMAND MET BY EL DORADO IRRIGATION DISTRICT

Month	In per cent of seasonal demand
January	6
February	6
March	6
April	6
May	8
June	10
July	12
August	13
September	12
October	8
November	7
December	6
TOTAL	100

The data listed in Table 26 were compiled from records of the El Dorado Irrigation District by the United States Bureau of Reclamation during studies for the Sly Park Project.

Permissible Deficiencies in Application Of Irrigation Water

Studies to determine deficiencies in the supply of irrigation water that might be endured without permanent injury to perennial crops were not made in connection with the Survey of Mountainous Areas. However, the results of past investigation and study of endurable deficiencies in the Sacramento River Basin are believed to be applicable to the Mother Lode Region. In this respect, the following is quoted from Division of Water Resources Bulletin No. 26, "Sacramento River Basin," 1931.

> "A full irrigation supply furnishes water not only for the consumptive use of the plant but also for evaporation from the surface during application and from the moist ground surface, and for water which is lost through percolation to depths beyond the reach of the plant roots. Less water can be used in years of deficiency in supply by careful application and by more thorough cultivation to conserve the ground moisture. In these ways the plant can be furnished its full consumptive use with much smaller amounts of water than those ordinarily applied and the yield will not be decreased. If the supply is too deficient to provide the full consumptive use, the plant can sustain life on smaller amounts but the crop yield will probably be less than normal.
>
> "It is believed from a study of such data as are available that a maximum deficiency of 35 per cent of the full seasonal requirement can be endured, if the deficiency occurs only at relatively long intervals. It is also believed that small deficiencies occurring at relatively frequent intervals can be endured."

The operation of reservoirs on the basis of an allowable deficiency in release of irrigation water during extremely critical dry years permits a larger average draft on storage without serious shortages of water. The effect is maximum utilization of storage facilities, from the standpoint of economy as well as water supply. It is considered that a maximum deficiency of 35 per cent of the seasonal irrigation requirement is permissible in any one year, if preceded and followed by years of full supply. When several deficiencies occur during a consecutive series of dry years, their total should not exceed 35 per cent. On the basis of the historical runoff of streams in the Mother Lode Region, and many reservoir studies, the above procedure for reservoir operation results in deficiencies in 1924, 1931, and 1934, the year of occurrence of deficiencies depending on the capacity of the reservoir in relation to the mean runoff of the stream. Small reservoirs may experience deficiencies in 1924 or 1931 or both; medium-capacity reservoirs in 1931 only; and large reservoirs in 1934 only.

ULTIMATE WATER REQUIREMENTS

The quantity of water which must be delivered to any given service area to satisfy ultimate consumptive use of applied water may be considered as the ultimate water requirement of the service area. This requirement may be computed by adjusting the estimate of ultimate consumptive use of applied water for estimated conveyance and application losses within the service area. In the Mother Lode Region the requirement will be satisfied principally by reservoir releases. A part of the requirement may be satisfied, however, by recoverable return flows originating within the area itself, and another part may be satisfied by return flow from upstream service areas. The term "service area requirement," therefore, does not signify "draft on reservoir." Since the service area requirement is affected by the location of project features, the most accurate estimate can be made only when the basic framework of the water supply project is established. Nevertheless, preliminary estimates of service area requirements are considerably more useful for project planning purposes than are estimates of consumptive use of applied water. As a first step in deriving such estimates, it can be assumed that, under conditions of ultimate development, the cost of water and the available supply of water will be such that conveyance and application losses will have to be reduced to a minimum, and that every effort must be made to recover return flows. On this basis, it is considered reasonable to assume that average irrigation efficiencies of 75 per cent can be accomplished;

TABLE 27

ESTIMATED ULTIMATE MEAN SEASONAL WATER REQUIREMENTS BY SERVICE AREAS, MOTHER LODE REGION

(In acre-feet)

County and service area	Requirement
Amador	
Ione	77,100
Jackson	22,400
Plymouth	20,000
Volcano	16,900
Subtotal, agricultural zone	136,400
National forest zone	700
Total, county	137,100
Butte	
Bidwell	6,900
Big Bend	7,300
Buckeye	8,000
Chico	5,600
Deer Creek	7,800
Magalia	26,800
Wyandotte	69,800
Subtotal, agricultural zone	132,000
National forest zone	2,300
Total, county	134,300
Calaveras	
Bear Mountain	38,000
Calaveras	30,700
Hogan	48,300
Mokelumne	30,800
Rock Creek	12,100
Stanislaus	25,800
West Point	6,000
Subtotal, agricultural zone	191,800
National forest zone	400
Total, county	192,200
El Dorado	
Aukum	19,000
Georgetown	27,400
Latrobe	12,400
Placerville	95,500
Youngs	12,500
Subtotal, agricultural zone	166,800
National forest zone	4,400
Total, county	171,200
Mariposa	
Baxter	8,000
Chowchilla	24,600
Hardin	11,400
Hornitos	30,000
Mariposa	8,600
White Rock	10,100
Subtotal, agricultural zone	92,700
National forest zone	700
Total, county	93,400
Merced	
Baxter	9,700
Chowchilla	1,500
Hornitos	5,800
Subtotal, agricultural zone	17,000
National forest zone	—
Total, county	17,000
Nevada	
Grass Valley	90,000
Spaulding	4,800
Tyler	6,900
Subtotal, agricultural zone	101,700
National forest zone	6,700
Total, county	108,400
Placer	
Colfax	32,400
Doty	99,200
Foresthill	24,000
Loomis	69,200
Subtotal, agricultural zone	224,800
National forest zone	4,400
Total, county	229,200
Sacramento	
Carson	74,800
Laguna	94,000
Subtotal, agricultural zone	168,800
National forest zone	—
Total, county	168,800
San Joaquin	
Arroyo Seco	35,000
Bear Creek	74,900
Subtotal, agricultural zone	109,900
National forest zone	—
Total, county	109,900
Stanislaus	
Blanchard	3,200
Keystone	1,500
Rock Creek	5,100
Subtotal, agricultural zone	9,800
National forest zone	—
Total, county	9,800
Tuolumne	
Blanchard	6,300
Groveland	19,200
Keystone	24,000
Lyons	12,500
Phoenix	35,900
Subtotal, agricultural zone	97,900
National forest zone	5,000
Total, county	102,900
Yuba	
Browns Valley	33,500
Challenge	39,400
Smartville	11,700
Strawberry	3,900
Subtotal, agricultural zone	88,500
National forest zone	6,200
Total, county	94,700
APPROXIMATE TOTAL, AGRICULTURAL ZONE	1,540,000
APPROXIMATE TOTAL, NATIONAL FOREST ZONE	30,000
APPROXIMATE TOTAL, REGION	1,570,000

that conveyance losses within the service area can be restricted to a quantity equivalent to 10 per cent of consumptive use of applied water; and that return flow can be recovered in quantities sufficient to balance the conveyance loss. Under these conditions, service area requirement would be equivalent to consumptive use of applied water plus 33 per cent. Service area requirements, computed on this basis, are presented in Table 27. With certain qualifications, the estimates can be used in project planning as a basis for determining probable drafts on reservoirs. Where appropriate, the possibility of recovering return flow from upstream areas should be considered as a means of satisfying a part of service area requirement, and thereby reducing the indicated draft on reservoir storage. Moreover, the situation in any given service area may be such that relatively large quantities of return flow originating within the area may be recovered and re-used. On the other hand, the probable conveyance loss between the service area and proposed reservoirs constitutes an additional draft on storage. Under the most unfavorable conditions with regard to recoverable return flow, the draft on reservoir storage to satisfy the service area requirement would be slightly larger than the quantities given in Table 27 by the amount of water lost in transit between the reservoir and the service area. Under favorable conditions, where return flows from upstream areas can be used to satisfy a part of the service area requirement, the draft on storage could be considerably less than the quantity listed in Table 27.

Nonconsumptive Water Requirements

The principal nonconsumptive requirements for water in the Mother Lode Region are those which apply to the generation of hydroelectric energy and to the support of fish and wildlife. Although these requirements do not result in the consumption of water or in the depletion of runoff, they are fundamental considerations in problems concerning the development and distribution of water for consumptive purposes.

The operation of the 43 existing hydroelectric plants on streams tributary to the Mother Lode Region imposes substantial demands for water. The 43 plants have a combined generating capacity of more than 1,000,000 kilowatts, and in 1951 they produced approximately 6,000,000,000 kilowatt-hours of electric energy, equal to about 35 per cent of the total energy demand of the northern California power market in that year. To varying degrees, all of the plants draw on stored water as well as on unregulated stream flow. Most of the plants are units of a power system which includes steam generating plants, and their demands for water vary from year to year and from plant to plant with such factors as the load on the system and the water supply. Based on the 1951 combined monthly output of the 43 plants, the monthly demands for water, expressed as percentages of the seasonal, and as acre-feet of water, are presented in Table 28. The quantities of water indicated in the table are approximations derived mathematically on the basis of known outputs, known heads, and assumed efficiencies of the 43 plants.

TABLE 28

ESTIMATED MONTHLY HYDROELECTRIC DEMANDS FOR WATER IN 1951, MOTHER LODE REGION

Month	Demands for water	
	Percent of annual total	Acre-feet
January	9.9	1,390,000
February	7.8	1,090,000
March	10.2	1,430,000
April	8.5	1,190,000
May	9.9	1,390,000
June	7.9	1,110,000
July	7.8	1,090,000
August	7.3	1,020,000
September	6.7	940,000
October	7.3	1,020,000
November	7.6	1,060,000
December	9.1	1,270,000
TOTALS	100.0	14,000,000

There is no doubt that future requirements for water for hydroelectric purposes will be much larger than they are today. It is estimated that, in terms of installed generating capacity, the hydroelectric potential of the streams tributary to the Mother Lode Region is in the order of 4,000,000 kilowatts, or about four times the present development as represented by the existing plants. New construction under way on the American, Stanislaus, and Tuolumne Rivers, however, will increase the existing hydroelectric generating capacity in the region by almost one-third within the next few years. It appears that the future growth of the load in the northern California power market will be sufficient to support large increases in hydroelectric development. The historical growth of the load, projected to 1960, is presented in Table 29. The data given in the table were taken from a report of the California Water Project Authority published in March, 1952, entitled "Feasibility of State Ownership and Operation of the Central Valley Project of California." The data indicate that additional development of the hydroelectric potential of the Mother Lode Region will not be restricted by lack of demand and markets.

One of the most important of the nonconsumptive requirements for water is that imposed by the generally recognized necessity for safeguarding and improving, where possible, the fish and wildlife resources of California stream basins. The mountain streams and lakes of the Mother Lode Region provide a great

TABLE 29

HISTORIC AND PROJECTED ELECTRIC ENERGY GENERATION FOR USE IN THE NORTHERN CALIFORNIA POWER MARKET

Year	Millions of kilowatt-hours	Peak demand, in thousands of kilowatts
1920	2,223	423
1930	4,926	911
1940	6,669	1,226
1950	15,348	2,746
1951	17,495	3,120
1960	31,280	5,670

trout fishery, and the mountain and foothill areas of forest, brush, and grasslands are the habitat of numerous species of big and small game animals and upland game birds. Warm-water game fishes such as black bass, sunfish, crappies, and catfish provide considerable sport fishing in the streams and reservoirs at lower elevations. Steelhead rainbow trout immigrate into some of the streams, particularly the Feather and American Rivers, and spawning beds of the king salmon exist principally along the lower reaches of the Feather, American, Cosumnes, and Mokelumne Rivers, and Butte Creek. Although the salmon fishery is not great in the region itself, the fish produced in its streams are important to other areas. The fish and wildlife resources of the region are valuable primarily for recreational and esthetic reasons. In general, they have no direct economic value, but their indirect economic value, which results from the production and sale of the goods and services required by sportsmen and tourists, is certainly substantial.

So far as requirements for water are concerned, the preservation and enhancement of fishery values involves the maintenance of stream flow at or above the minimum stages required to support fish life. The support and preservation of game animals and fowl in the region is primarily a matter of maintenance of habitat. In general, this requirement does not result in direct demands for water beyond those required to maintain live streams to support fish life. The maintenance of the mashland areas favored as nesting grounds by migratory waterfowl and by some types of animals sometimes results in a requirement for water, but this type of habitat does not exist to a significant extent in the Mother Lode Region. For purposes of this bulletin, it is considered that the requirements for water to support fish life are sufficient to support other types of wildlife as well.

It is generally recognized that reservoirs and diversions should be operated in such a manner that a live stream is maintained at all times. The quantities of water which should be released, or allowed to pass the reservoir or diversion, vary with the size of the stream, and it is not possible, therefore, to specify fish requirement in general. In small streams a minimum flow of five second-feet or less is often sufficient for the purpose, while a minimum flow of 100 second-feet or more may be required in large streams. During the late summer months the natural flow of all Sierra Nevada streams normally drops to very low stages, and some of the minor streams dry up completely. During such periods the optimum flows for fish support may often exceed the natural runoff, so that releases of stored water would be desirable to maintain such optimum flows. In this connection, the following is quoted from the Fish and Game Code of the State of California.

> "Sec. 525. The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around, or through the dam, to keep in good condition any fish that may be planted or exist below the dam."

This requirement is a source of controversy, since it is obvious that, while a reservoir owner could not reasonably object to passing natural runoff through the reservoir, he might object to mandatory and uncompensated releases of stored water for the maintenance of optimum flows for fish support on the grounds that the benefits from such releases of stored water would accrue to the people as a whole, and that he should not be required, therefore, to stand the entire cost of developing the necessary water supply.

It is probable that, in many instances, such water as is required for the maintenance of optimum flow for fish may be satisfied from waste and return flows. Where economic hardship might result from mandatory and uncompensated releases of stored water, the expenditure of public funds may be justified. In connection with current investigations for The California Water Plan, the Division of Water Resources is conducting studies in cooperation with the Department of Fish and Game with the object of determining the water requirements for fish and wildlife on California streams, and of making adequate provisions for such requirements in forthcoming comprehensive plans for water development. It is pointed out that the maintenance of minimum stream flows for the support of fish and wildlife results in an indirect benefit to such recreational activities as swimming and boating.

STREAM DEPLETION

The streams of the Mother Lode Region contribute about 25 per cent of the total runoff of the entire State. They are major sources of water supply for large agricultural and urban areas lying outside the region where the water originates, and valid water rights covering substantial diversions to such areas have been in existence for a long time. In order to support and permit a continued expansion of population, agriculture, and industry in the State, the forthcoming California Water Plan contemplates maximum development and utilization of the water resources of the entire State. Since the water resources of the Mother Lode Region constitute a major part of California's water supply, it is evident that in the future they must furnish water for export to other parts of the State to the greatest possible extent. For this reason the effect of maximum water utilization within the Mother Lode Region on the outflow from the region is a matter of general interest and concern.

The extent of stream depletion due to large-scale development and utilization of water in upstream areas is not susceptible to precise determination due to uncertainties in the evaluation of the basic factors involved. Although the criteria are general, these factors are best described from the standpoint of a hypothetical case: That all water requirements within the stream basin are satisfied from within the watershed, and that there is no import to or export of water from the stream basin above the edge of the valley floor. On this basis, the evaluation of probable stream depletion involves solution of the following equation.

Stream depletion = Water requirement + Irrecoverable losses — Accruals to runoff

The first term of the equation is self-explanatory, but the other two require clarification. The term "irrecoverable losses" means the water which is unavoidably consumed, in the course of the development and distribution of water, by nonproductive processes. Evaporation from reservoirs is a nonproductive consumption of water. From the standpoint of stream depletion, percolation to ground water is generally an irrecoverable loss, although the water may accrue to valley floor ground water basins. For purposes of this discussion, however, it can be assumed that there is no percolation to ground water from applied water in the mountain and foothill areas. Insofar as is known, there are no ground water basins of significance anywhere in the Mother Lode Region, and, moreover, the topography is generally favorable to surface runoff and unfavorable to percolation. By far the most important of these irrecoverable losses are those which result from the conveyance and application of water to irrigated lands. These losses consist of the consumptive use of developed water by native vegetation.

The term "accruals to runoff" refers to a possible increase in natural runoff resulting from the development of irrigable lands. At higher elevations many tracts classified as irrigable are covered by moderate to heavy brush or stands of timber. It would seem reasonable to assume that the clearing of these lands and the planting of such irrigated crops as deciduous orchards and pasture would tend to increase the winter runoff to the extent of any differences in consumptive use of winter precipitation. At low elevations, where natural cover is sparse and precipitation is small, no accrual to natural runoff could be expected through the development of the potentially irrigable lands. While a change in land use in marshy areas could result in an accrual to natural runoff at any elevation, the extent of such areas in the region as a whole is not significant.

On the basis of the above discussion, it is obvious that the evaluation of stream depletion is an extremely complex problem, the solution of which would vary from area to area with such factors as topography, pattern of irrigable land, character of natural cover, irrigation efficiency, and other factors. The voluminous data which would be required to support even an approximate evaluation do not exist, and they have not been compiled in the course of the current investigation.

CHAPTER IV

PLANS FOR WATER DEVELOPMENT

It has been shown that substantial surplus flows of water are presently available from many of the major and minor streams of the Mother Lode Region. Studies described in this chapter indicate that these surplus flows, if properly controlled and regulated, could more than meet the ultimate water requirements of the region.

As was stated in Chapter I, the Division of Water Resources is presently conducting the State-wide Water Resources Investigation under direction of the State Water Resources Board. This investigation has as its objective the formulation of The California Water Plan, for full conservation, control, protection, and utilization of the State's water resources, to meet present and future water needs for all beneficial purposes in all parts of the State, insofar as practicable.

Although the state-wide investigation is still in progress, it is sufficiently advanced to permit preliminary description of certain major features of The California Water Plan which could provide supplemental water to assist in meeting the probable ultimate requirements of the Mother Lode Region. The projects would also provide supplemental supplies for other water-deficient areas of California. In addition, benefits from the projects would include hydroelectric power, flood and salinity control, and benefits in the interests of recreation and preservation of fish and wildlife. In general, the cited major features of The California Water Plan in the Mother Lode Region would be multipurpose projects requiring relatively large capital expenditures, and their scope, with regard to both location of the works and benefits derived from their operation, would not be limited to any one local area but would embrace other large portions of California.

In connection with the Survey of Mountainous Areas, various plans were considered for local development of the water resources of Sierra Nevada streams, for the primary purpose of meeting future water requirements in the Mother Lode Region. However, any future development and use of water in the foothill and mountainous service areas of the region will correspondingly affect the development of supplemental water supplies for downstream valley floor lands and for export to other parts of the State. The planning surveys and studies for the Survey of Mountainous Areas, therefore, were necessarily coordinated to the extent that such could be done at the time with those for the state-wide investigation.

The preliminary plans for satisfying the ultimate water requirements of the Mother Lode Region presented herein are described in general terms, and primarily for the purpose of demonstrating that they are feasible from the physical and engineering standpoint. These plans are not necessarily the only plans nor the most feasible, and studies under the state-wide and possible future investigations may indicate the desirability of modifications.

In connection with plans for water development for the Mother Lode Region, effort was made to incorporate hydroelectric power features where feasible. While the operation of power features was considered incidental to the primary purpose of conservation of water for domestic, municipal, irrigation, and other beneficial consumptive uses, substantial benefits from power generation would be forthcoming.

With anticipated continued growth of population in California, it is expected that the public demand for preservation and enhancement of recreational facilities will be sufficient to assure provision of the water supplies necessary for these purposes. In the aggregate, the amount of water used for domestic and service facilities in recreational areas of the Mother Lode Region would be relatively minor. As for waters employed for boating, swimming, and other water sports, most would be available naturally or as a result of works constructed and operated for other purposes, and the nonconsumptive recreational use of the water would be incidental to the other uses. However, of considerable importance among the employments of water for recreation would be those associated with the preservation and propagation of fish and wildlife.

So far as is known, no artificial lakes in the Mother Lode Region are now utilized exclusively for fish life, this use being incidental to the primary purposes for which the reservoirs were constructed. However, the levels of a number of small natural lakes on the headwaters of streams have been raised by the California Department of Fish and Game, and releases of the stored water are made to maintain downstream flow conditions in summer and fall that are favorable to fish life. The Department of Fish and Game has plans for similarly raising the level of and operating an additional number of natural lakes. It is considered probable that in the future more reservoir storage capacity will be allocated to this purpose, and that in some instances reservoirs will be constructed exclusively to augment the natural low summer and fall flows in the interests of fish life. Comprehensive developments of these types are contemplated in The California Water Plan. Furthermore, releases of water from multipurpose reservoirs are contemplated for the purpose of maintaining adequate stream flows for fish life.

General discussions of probable ultimate water requirements, and of the nature and extent of plans for water development for the Mother Lode Region are presented in this chapter. These matters are discussed separately by service areas or by groups of service areas, beginning on the north in Butte County and extending to the south in Mariposa County. The discussions do not include consideration of economic or financial feasibility of the possible water development works. Locations of the principal features of the plans are shown on Plate 16, entitled "Plans for Water Development, 1954."

The plans described herein to meet the probable ultimate water requirements of the Mother Lode Region consider 46 dams and reservoirs and 21 hydroelectric power plants, as well as the enlargement of 12 existing dams and reservoirs and 8 power plants. Under the plans the aggregate reservoir storage capacity in the Mother Lode Region would be increased by some 3,500,000 acre-feet. The installed hydroelectric power capacity in the region would be increased by about 680,000 kilowatts. The increase in hydroelectric energy produced would be on the order of 2,900,000,000 kilowatt-hours seasonally. The total safe seasonal yield of water under the plan of development would be about 3,360,000 acre-feet, to meet a probable ultimate seasonal water requirement in the agricultural zone of the Mother Lode Region of some 1,540,000 acre-feet.

DEER CREEK, CHICO, MAGALIA, AND BIG BEND SERVICE AREAS

These service areas, Nos. 1, 2, 3, and 4 on Plate 16, have estimated ultimate mean seasonal water requirements of 7,800 acre-feet, 5,600 acre-feet, 26,800 acre-feet, and 7,300 acre-feet, respectively, or a total of 47,500 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve the construction of dams and reservoirs on Butte and Little Butte Creeks, and utilization and enlargement of certain existing works in and adjacent to the service areas. The estimated safe seasonal yield of water under the plan would be about 105,000 acre-feet.

The plan would provide for construction of three dams and reservoirs on Butte Creek, one on Little Butte Creek, and enlargement of the existing Magalia Reservoir. The uppermost dam on Butte Creek would be located at Butte Creek House, about 3 miles north of the existing Round Valley Reservoir. Stream bed elevation at the site of the proposed dam is about 5,750 feet, and storage capacity of the reservoir would be about 9,400 acre-feet. Downstream from Butte Creek House Reservoir, a dam would be constructed at Grizzly Gulch at a site where the stream bed elevation is about 4,000 feet. Grizzly Gulch Reservoir would have a storage capacity of approximately 7,900 acre-feet. The other dam on Butte Creek would be constructed at a site at the Forks of Butte, about 8 miles north of Magalia, where the stream bed elevation is approximately 2,060 feet. Forks of Butte Reservoir would have a storage capacity of about 49,700 acre-feet. A dam would also be constructed on Little Butte Creek at its junction with Mosquito Creek, creating the Mosquito Junction Reservoir with a storage capacity of about 6,500 acre-feet. Stream bed elevation at the dam site is about 2,400 feet. Downstream from Mosquito Junction Reservoir, Magalia Reservoir would be enlarged from its present storage capacity of 3,300 acre-feet to a capacity of 6,400 acre-feet. Stream bed elevation at the dam is about 2,170 feet.

The Deer Creek Service Area would be supplied with water from the proposed Butte Creek House Reservoir. Water released from the reservoir would be diverted from Butte Creek about 8 miles downstream from Butte Creek House Dam. Stream bed elevation at the site of the diversion is about 4,400 feet. The diverted water would be conveyed by canal to Chico Creek. The canal would head in a westerly direction and would be about 1,000 feet in length. From Chico Creek water would be rediverted at a site where the stream bed elevation is about 3,600 feet. The diverted water would be conveyed to the Deer Creek Service Area in a canal approximately 17 miles in length, leading in a southwesterly direction.

The Chico Service Area would be supplied with water from the proposed Grizzly Gulch Reservoir. Water released from the reservoir would be diverted from Butte Creek at a site about 5 miles downstream from the reservoir where the stream bed elevation is approximately 2,850 feet. The diverted water would be conveyed to the service area in a conduit about 10 miles in length, leading in a southwesterly direction. A portion of the water supplied from Grizzly Gulch Reservoir would be furnished by releases from Butte Creek House Reservoir, located upstream from Grizzly Gulch Reservoir.

The Magalia and Big Bend Service Areas would be supplied with water to meet their requirements from works developed on Butte and Little Butte Creeks. Water released from Butte Creek House Reservoir on Butte Creek would flow to Grizzly Gulch Reservoir, where it would be released for diversion from Butte Creek into the existing conduit of the Pacific Gas and Electric Company leading to the forebay of the company's De Sabla Power Plant. Elevation of the stream bed at the point of diversion from Butte Creek is approximately 2,800 feet. The conduit leading to the De Sabla Power Plant forebay would be enlarged to carry the additional water required. From the forebay of the De Sabla Power Plant a portion of the water conveyed from Butte Creek would be released to Little Butte Creek, where it would be stored in Mosquito Junction Reservoir. Water released from Mosquito Junction Reservoir and enlarged Magalia Reservoir, located downstream, would be conveyed to supply a portion of the requirements of the Magalia and Big Bend Service Areas. The remainder of the requirement would be supplied from Forks of Butte Reservoir by means of a conduit, 14 miles in length, leading in a southerly direction from the reservoir along the ridge separating Butte and Little Butte Creeks to below Magalia Reservoir. The water conveyed from Forks of Butte Reservoir would augment releases from Magalia Reservoir.

BUCKEYE SERVICE AREA

This service area, No. 5 on Plate 16, has a probable ultimate mean seasonal water requirement of 8,000 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve the construction of a dam and reservoir on the upper reaches of the Little North Fork of the Feather River, diversion of the conserved water through a tunnel to Peavine Creek, rediversion of the flows from Peavine Creek, and their conveyance by canal to areas of use. The estimated safe seasonal yield under this plan would be about 10,000 acre-feet.

The plan would provide for a reservoir of about 12,000 acre-foot storage capacity on Arkansas Ravine, about 5 miles south of Bucks Creek Lake. Stream bed elevation at the dam site is about 4,800 feet. Water released from Arkansas Ravine Reservoir would be diverted from the Little North Fork about 7 miles downstream from the dam into a tunnel driven westward through the ridge to Peavine Creek. The elevation of the stream bed at the point of diversion is about 2,700 feet. The tunnel would be about 1.5 miles in length, and would terminate at an elevation of about 2,670 feet. The water would be rediverted from Peavine Creek near the outlet of the tunnel and conveyed in a canal about 12 miles in length in a southwesterly direction to areas of use in the Buckeye Service Area.

BIDWELL SERVICE AREA

This service area, No. 6 on Plate 16, has an estimated ultimate mean seasonal water requirement of 6,900 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve the construction of a dam and reservoir on upper Fall River, and conveyance of the conserved water to areas of use in the service area. The estimated safe seasonal yield under the plan would be about 8,500 acre-feet.

The plan would provide for a reservoir of about 6,000 acre-foot storage capacity on upper Fall River, about 9 miles above the junction with the Middle Fork of the Feather River. Stream bed elevation at the dam site is about 3,900 feet. Water released from Fall River Reservoir would be diverted from Fall River below the dam and conveyed in a canal along the left bank for a distance of about 20 miles to areas of use in the Bidwell Service Area.

WYANDOTTE, CHALLENGE, STRAWBERRY, AND BROWNS VALLEY SERVICE AREAS

These service areas, Nos. 7, 8, 9, and 10 on Plate 16, have estimated ultimate mean seasonal water requirements of 69,800 acre-feet, 39,400 acre-feet, 3,900 acre-feet, and 33,500 acre-feet, respectively, or a total of 146,600 acre-feet. They could be supplied with water to meet these requirements by a plan for multipurpose development of the South Fork of the Feather River and adjacent streams, and conveyance of the conserved water to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 185,000 acre-feet. The installed hydroelectric power capacity would total about 98,500 kilowatts, and it is estimated that the power plants would produce about 327,000,000 kilowatt-hours of electric energy seasonally.

The plan contemplates the construction of Little Grass Valley Dam and Reservoir on the South Fork of the Feather River. Stream bed elevation at the dam site is about 4,880 feet, and the storage capacity of the reservoir would be 50,500 acre-feet. Water released from this reservoir would be diverted from the South Fork about 6 miles below the dam at a point where the stream bed elevation is 3,925 feet. The water would be conveyed southerly through a tunnel about 2.3 miles in length to Lost Creek. Most of the water would flow down the creek to Enlarged Lost Creek Reservoir, but a portion of the water would be diverted to Sly Creek and from there be rediverted to serve the Strawberry Service Area and a portion of the Wyandotte Service Area. Enlarged Lost Creek Reservoir would be created by construction of a dam approximately at the site of the existing structure where the stream bed elevation is 3,195 feet. The reservoir would be enlarged from its present storage capacity of 5,200 acre-feet to about 140,000 acre-feet.

The plan also contemplates the construction of a small diversion dam on Canyon Creek, a tributary of the Yuba River, where the stream bed elevation is about 3,810 feet. From the Canyon Creek Diversion, water would be conveyed westerly through a tunnel about 4.3 miles in length to a proposed diversion located on Slate Creek where the stream bed elevation is about 3,490 feet. From Slate Creek the waters of Slate and Canyon Creeks would be conveyed westerly through a tunnel about 2.2 miles in length to a point on Lost Creek above Enlarged Lost Creek Reservoir.

Releases from Lost Creek Reservoir would be made into an enlarged Forbestown Ditch and to the proposed Woodleaf Power Plant, located on the South Fork of the Feather River at an elevation of about 1,770 feet. Woodleaf Power Plant would have an installed capacity of 66,000 kilowatts, operating under a maximum static head of 1,740 feet. Water would be conveyed to the Woodleaf Power Plant from Lost Creek Reservoir in a tunnel 3.2 miles in length, leading in a westerly direction. Releases from the Woodleaf Power Plant would be rediverted at the afterbay of the plant at a stream bed elevation of about 1,700 feet. The water would be conveyed in a tunnel 3.5 miles in length, leading in a westerly direction to the proposed Forbestown Power Plant, located on the South Fork of the Feather River where the stream bed elevation is about 960 feet. The installed capacity of the plant would be 32,500 kilowatts, operating under a static head of 810 feet. Releases from the Forbestown Power Plant would be reregulated in an afterbay formed by a dam located at a site where the stream bed elevation is 825 feet. The reregulated water would be conveyed by canal from the afterbay along the left bank of the South Fork, a distance of some 10 miles, and the canal would then turn southerly for a distance of about 8 miles. Water would be released en route to supply lands in portions of the Wyandotte and Browns Valley Service Areas in all of the Challenge Service Area. The remainder of the water required to supply the Browns Valley Service Area would be furnished from the proposed Virginia Ranch Reservoir, which would have a storage capacity of 36,000 acre-feet. Virginia Ranch Dam would be located on Dry Creek where the stream bed elevation is about 1,050 feet. The dam would be located northwest of the existing Englebright Reservoir on the Yuba River.

TYLER AND GRASS VALLEY SERVICE AREAS

These service areas, Nos. 11 and 13 on Plate 16, have estimated ultimate mean seasonal water requirements of 6,900 acre-feet and 90,000 acre-feet, respectively, or a total of 96,900 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve conservation of the waters of the South Fork of the Yuba River and Deer Creek, and conveyance of the conserved waters to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 225,000 acre-feet. The installed hydroelectric power capacity would total about 64,300 kilowatts, and it is estimated that the power plants would produce about 237,000,000 kilowatt-hours of electric energy seasonally.

The plan contemplates construction of Washington Dam and Reservoir on the South Fork of the Yuba River, about 8 miles northeast of the existing Scotts Flat Reservoir on Deer Creek. Stream bed elevation at the site of the proposed dam is about 2,420 feet and storage capacity of the reservoir would be about 125,800 acre-feet. Water released from the reservoir would be conveyed westerly through 11.4 miles of tunnel and 2 miles of pipe line to the proposed Devils Slide Power Plant, located on the South Fork of the Yuba River. The power plant would be located at an elevation of about 1,400 feet and would have an installed hydroelectric power capacity of 40,600 kilowatts, operating under a gross static head of approximately 1,400 feet. From the head of the penstock of the power plant water would be siphoned across the South Fork of the Yuba River to supply water to the Tyler Service Area. From the forebay of the Devils Slide Power Plant water would be conveyed in a southerly direction to supply a portion of the Grass Valley Service Area. Releases from the power plant would be reregulated in an afterbay, formed by a dam located at a stream bed elevation of about 1,330 feet. Water from the afterbay would be conveyed westerly through a tunnel 7.5 miles in length to the penstock of the proposed Jones Bar Power Plant, which would be located on the edge of existing Englebright Reservoir. This plant would be located at a point where the stream bed elevation is 527 feet. The plant would have an installed hydroelectric capacity of 23,700 kilowatts, operating under a maximum static head of 775 feet.

The remainder of the Grass Valley Service Area would be supplied with water under a plan which would provide for the enlargement of the existing Scotts Flat Reservoir on Dry Creek. Scotts Flat Reservoir, with a storage capacity of 26,300 acre-feet, would be enlarged to about 62,500 acre-feet. Scotts Flat Dam is located on Deer Creek about 3.5 miles east of Nevada City, where the stream bed elevation is approximately 2,910 feet. Water released from the reservoir would be conveyed to irrigable lands in the service area through canals and conduits presently serving the area.

SMARTVILLE SERVICE AREA

This service area, No. 12 on Plate 16, has an estimated ultimate mean seasonal water requirement of 11,700 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve diversion of water from the Yuba River and conveyance of this water in a southerly direction to serve the service area. Water from the existing Bullards Bar and Englebright Reservoirs, located on the Yuba River, would be utilized for this purpose. The safe seasonal yield from these reservoirs under this plan would be about 300,000 acre-feet. The plan would involve construction of a conduit diverting water at the existing Englebright Dam at an elevation of 496 feet, and conveyance of this water generally in a southerly direction to the service area.

SPAULDING SERVICE AREA

This service area, No. 14 on Plate 16, has an estimated ultimate mean seasonal water requirement of 4,800 acre-feet. The service area would be supplied with water to meet its requirement from the existing forebay of the Deer Creek Power Plant, located on Deer Creek. The water would be diverted at an elevation of approximately 4,500 feet and conveyed by canal a distance of about 7.5 miles to the service area.

DOTY, COLFAX, AND LOOMIS SERVICE AREAS

These service areas, Nos. 15, 16, and 18 on Plate 16, have estimated ultimate mean seasonal water requirements of 99,200 acre-feet, 32,400 acre-feet, and 69,200 acre-feet, respectively, or a total of 200,800 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve developments on the Yuba, Bear, and American Rivers, and conveyance of the conserved waters to the respective service areas. The estimated safe seasonal yield under this plan would be about 1,200,000 acre-feet. The increase in installed hydroelectric power capacity would be about 244,000 kilowatts, and about 765,000,000 kilowatt-hours of new electrical energy would be produced seasonally.

The plan contemplates construction of a dam and reservoir at Jackson Meadows on the Middle Fork of the Yuba River, and diversion of water from the South Fork of the North Fork of the Yuba River immediately below Haypress Valley and its conveyance to the reservoir. Stream bed elevation at the site of the proposed Haypress Diversion is 6,253 feet. The diverted water would be conveyed southerly through a tunnel a distance of about 3 miles to Jackson Meadows Reservoir. Stream bed elevation at the Jackson Meadows dam site is 5,865 feet. The site is located about 2 miles upstream from Milton. The storage capacity of the reservoir would be about 45,000 acre-feet. Water released from Jackson Meadows Reservoir would be diverted downstream at Milton and would then be conveyed through the Milton-Bowman Tunnel to Bowman Lake. From Bowman Lake the water would be conveyed through the Bowman-Spaulding Conduit to Lake Spaulding. Water from Lake Spaulding would be released to the South Yuba Canal which conveys water to Deer Creek, to the Drum System of the Pacific Gas and Electric Company on the Bear River, and to the Boardman Canal located on the ridge between the Bear River and North Fork of the American River.

The plan contemplates no enlargement of Spaulding Power Plants Nos. 1 and 2, but the installed hydroelectric power capacity would be increased at Spaulding No. 3, Drum, Dutch Flat, and Deer Creek Power Plants. Spaulding Power Plant No. 1 is located in the excavated granite wall of the canyon on the left bank just below Lake Spaulding. This power plant, with a capacity of 6,400 kilowatts at an elevation of 4,829 feet, operates under a maximum static head of 196 feet. Spaulding Power Plant No. 2, located below Spaulding Power Plant No. 1 at an elevation of 4,679 feet, has an installed capacity of 3,400 kilowatts and operates under a maximum static head of 346 feet. Spaulding Power Plant No. 3, at an elevation of 5,025 feet, is located at the terminus of the Bowman-Spaulding Conduit leading to Lake Spaulding. The installed hydroelectric power capacity of this plant would be increased from 6,300 kilowatts to 9,100 kilowatts, and it would operate under a maximum static head of 318 feet. The Drum Power Plant is located on the Bear River where the stream bed elevation is approximately 3,400 feet. The installed hydroelectric power capacity of this plant would be increased from 44,000 kilowatts to 80,000 kilowatts, operating under a total head of 1,375 feet. The Dutch Flat Power Plant is located on the Bear River where the stream bed elevation is about 2,710 feet. The capacity of this plant would be increased from 22,000 kilowatts to 32,000 kilowatts, operating under a total head of 640 feet. The Deer Creek Power Plant is located on Deer Creek where the stream bed elevation is about 3,660 feet. The capacity of this plant would be increased from 5,500 kilowatts to 13,600 kilowatts, operating under a total head of 840 feet. Water from the afterbay of the Deer Creek Power Plant would be conveyed in a conduit for a distance of about 8 miles to the penstock of the proposed Scotts Flat Power Plant on Deer Creek. The installed power capacity of this plant, which would be located at the upstream edge of the enlarged Scotts Flat Reservoir, would be about 5,000 kilowatts. The static head available at the plant would be approximately 520 feet.

The plant would also include the conservation of waters of the South Fork of the Yuba River above Lake Spaulding. The conserved waters would be supplied to the Doty, Colfax, and Loomis Service Areas. The capacity of the existing Lake Valley Reservoir on the North Fork of the North Fork of the American River, located about 3 miles east of Emigrant Gap, would be enlarged from 8,127 acre-feet to 41,000 acre-feet. Stream bed elevation at Lake Valley Dam is about 5,700 feet. Water from the existing Fordyce Lake on Fordyce Creek, and from Rattlesnake Creek, would be diverted and conveyed to the enlarged Lake Valley Reservoir. Fordyce Lake is located about 10 miles upstream from Lake Spaulding. Stream bed elevation at Fordyce Lake Dam is about 6,360 feet. Water released from Fordyce Lake would be diverted just below the dam and conveyed southerly to Rattlesnake Creek through a flume 2.5 miles in length and a tunnel 1 mile in length. The combined flow of water of Fordyce Lake and Rattlesnake Creek would be diverted from the creek about 1.5 miles below the tunnel outlet from Fordyce Lake. Stream bed elevation at the point of diversion is about 5,930 feet. The water would be conveyed southerly through 1.5 miles of flume and 0.5 mile of inverted siphon under the South Fork of the Yuba River, and would be discharged into the proposed South Yuba River Diversion Conduit leading to Lake Valley Reservoir. This conduit would divert water from the South Fork of the Yuba River about 4.5 miles east of Cisco where the stream bed elevation is approximately 5,950 feet. The water would be conveyed from the point of diversion generally in a westerly direction about 5.5 miles to a tunnel about 1 mile in length. This tunnel would convey the combined flows from Fordyce Lake, Rattlesnake Creek, and the South Fork of the Yuba River through the ridge separating the watersheds of the Yuba and American Rivers into Lake Valley Reservoir. From Lake Valley Reservoir the water would be conveyed in a pipe line 2 miles in length to the penstock of the proposed Lake Valley Power Plant, which would be located on the flow line of Lake Spaulding at an elevation of about 5,025 feet. The static head available to the plant would be approximately 815 feet, and the installed hydroelectric power capacity would be about 20,000 kilowatts.

It is also proposed that a dam and reservoir and power facilities be constructed at the Rollins site on the Bear River, approximately 2 miles north of Colfax. Stream bed elevation at the dam site is about 1,950 feet. The reservoir would have a storage capacity of about 100,000 acre-feet. From the afterbay of the existing Dutch Flat Power Plant on the Bear River, water would be conveyed in a conduit along the right bank of the river to the proposed Chicago Park Power Plant, which would be located at the confluence of Bear River and Steep Hollow Creek upstream from Rollins Reservoir. The installed hydroelectric power capacity of this plant would be about 27,500 kilowatts. The conduit leading to the plant would be approximately 6 miles in length and the static head available to the plant would be about 490 feet. In addition, a power plant would be constructed immediately downstream from Rollins Dam. The Rollins Power Plant would have an installed hydroelectric power capacity of about 15,000 kilowatts, and the maximum static head available to the plant would be about 240 feet. Releases from Rollins Reservoir would be discharged into the existing Bear River Canal, and would be conveyed to serve portions of the Colfax, Doty, and Loomis Service Areas.

Irrigable lands situated in the Colfax and Loomis Service Areas would continue to be supplied as at present from the Boardman Canal. The Boardman Canal diverts water from the Bear River about 1 mile west of Emigrant Gap and supplies water to the Alta Power Plant, located 1 mile west of Baxter. It then continues southwesterly, serving lands along the divide between the American and Bear Rivers and in the vicinity of the forebay of the Halsey Power Plant. The canal then continues to its termination near Roseville. Under the proposed plan the hydroelectric power capacity of the Halsey Power Plant, which is located about 4.5 miles northeast of Auburn, would be increased from 12,000 kilowatts to 13,500 kilowatts.

Irrigable lands in the Doty Service Area would be supplied with water from the afterbay of the Halsey Power Plant, located on a tributary of Coon Creek, from the existing Lake Combie Reservoir on the Bear River, and from the proposed Auburn Reservoir located on the North Fork of the American River. Stream bed elevation at the afterbay is 1,509 feet. From the Halsey afterbay water would be conveyed by a canal 6 miles in length to the Wise Power Plant, which is located on U.S. Highway 40 about 1.5 miles southwest of Auburn. The hydroelectric power capacity of the Wise Power Plant would be increased from 12,000 kilowatts to 20,000 kilowatts. The Halsey and Wise Power Plants are supplied with water from the Bear River Canal, which conveys water from the Bear River at a point immediately downstream from the proposed Rollins Dam.

Under the plan the proposed Auburn Dam would be located on the North Fork of the American River at a site where the stream bed elevation is approximately 460 feet. The dam site is about 3 miles south and east of Auburn. The storage capacity of Auburn Reservoir would be about 868,000 acre-feet. The proposed Auburn Power Plant would be located immediately downstream from Auburn Dam. The hydroelectric power capacity of the plant would be about 110,000 kilowatts. From Auburn Reservoir the proposed Auburn-Wise Tunnel would be driven to Auburn Ravine. The tunnel would be utilized to convey winter power releases of water from the Wise Power Plant to Auburn Reservoir, as well as releases from Auburn Reservoir during the irrigation season to supply lands adjacent to Auburn Ravine.

The northern portion of the Doty Service Area would be served as at present from Lake Combie Reservoir on the Bear River. Water released from this reservoir is conveyed by canal along the left bank of the Bear River for a distance of about 2 miles. The canal then turns southerly, branching into several main laterals to serve lands as far south as Auburn Ravine.

FORESTHILL SERVICE AREA

This service area, No. 17 on Plate 16, has an estimated ultimate mean seasonal water requirement of 24,000 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve development of the waters of minor streams lying between the North and Middle Forks of the American River and conveyance of the waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 24,700 acre-feet.

The plan contemplates conservation of the waters of Secret Canyon, Black Canyon, El Dorado Creek, and Bullion Creek. These waters would be diverted and conveyed in a general westerly direction in a canal a distance of about 39 miles to the proposed Forbes Creek Reservoir, into which a portion of the waters would be discharged. The remaining waters would be conveyed for an additional short distance and discharged into an enlarged Big Reservoir, located on a tributary of Forbes Creek. Water discharged into Big Reservoir in excess of the storage capacity would be spilled and conserved downstream in the proposed Sugar Pine Reservoir on North Shirttail Canyon. Waters in Forbes Creek and Sugar Pine Reservoirs would be released to canals to serve irrigable lands on the Foresthill Divide south of Shirttail Canyon. The water in Big Reservoir would be released to a canal to serve lands in the vicinity of Iowa Hill and lands situated generally west of North Shirttail Canyon.

The proposed diversion works on Secret Canyon would be located at a site where the stream bed elevation is about 4,430 feet. The diverted water would be conveyed in a canal in a westerly direction for 0.5 mile to Black Canyon. The waters of Secret and Black Canyons would be diverted from Black Canyon at a site where the stream bed elevation is about 4,415 feet, and conveyed in a canal generally in a southwesterly direction a distance of about 17 miles to El Dorado Creek. The canal would intercept enroute the runoff from a portion of the drainage area tributary to Secret Canyon and El Dorado Creek above the canal.

The combined diverted flows of Secret and Black Canyons, and those of El Dorado Creek, would be diverted from the latter creek at a site where the stream bed elevation is about 4,290 feet. The water would be conveyed in a canal a distance of 8.5 miles to discharge into Bullion Creek. Runoff from a portion of the drainage area tributary to El Dorado and Bullion Creeks lying above the canal would be intercepted enroute. The combined diverted flows, including water of Bullion Creek, would be diverted from Bullion Creek at a site where the stream bed elevation is about 4,220 feet. The waters would be conveyed through a canal a distance of about 13 miles to Forbes Reservoir, where a portion of the flow would be released at an elevation of 4,142 feet. The canal would continue northerly a distance of about 1 mile to discharge at an elevation of 4,137 feet into the enlarged Big Reservoir. The canal would intercept runoff enroute from a portion of the drainage area tributary to Volcano and Brimstone Creeks lying above the canal.

Forbes Dam would be located on Forbes Creek about 8 miles northeast of Foresthill. The stream bed elevation at the dam site is 3,875 feet, and the storage capacity of the reservoir would be 5,300 acre-feet. A proposed canal would convey water from the reservoir in a southerly direction for a distance of approximately 9 miles to a point about 5 miles northeast of Foresthill, where the elevation is about 3,800 feet. Water would be diverted enroute from the canal and distributed to irrigable lands.

The Morning Star Dam, creating Big Reservoir, is located on a tributary of Forbes Creek about 8 miles northeast of Foresthill. The stream bed elevation at the dam is 4,026 feet, and the storage capacity of the reservoir would be increased from the present 2,200 acre-feet to about 6,500 acre-feet. The proposed canal from Big Reservoir would convey water in a westerly direction a distance of about 5 miles to a point some 4 miles northeast of Iowa Hill, where the elevation is about 3,900 feet. Water would be diverted enroute from the canal and distributed to irrigable lands.

Sugar Pine Dam would be located at a site on North Shirttail Canyon about 2 miles west of Big Reservoir. The stream bed elevation at the site is 3,510 feet, and the storage capacity of the reservoir would be 17,000 acre-feet. The proposed canal from Sugar Pine Reservoir would convey water from the reservoir in a southerly direction a distance of about 17 miles to a point approximately 1 mile northeast of Foresthill, where the elevation is about 3,300 feet. Water would be diverted enroute from the canal and distributed to irrigable lands.

GEORGETOWN SERVICE AREA

This service area, No. 19 on Plate 16, has an estimated ultimate mean seasonal water requirement of 27,400 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve construction of a dam and reservoir on Pilot Creek. Water conserved in the reservoir would be augmented by diversions from Gerle Creek, South Fork of the Rubicon River, and Onion Creek. Existing conduits would be improved and enlarged to convey the conserved waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 38,600 acre-feet.

The plan contemplates construction of a dam and reservoir at the Stumpy Meadows site on Pilot Creek. The stream bed elevation at the dam site is about 4,110 feet, and the storage capacity of Stumpy Meadows Reservoir would be about 47,500 acre-feet.

The Gerle Creek Diversion would comprise the existing diversion structure on Gerle Creek and 2.3 miles of the existing Georgetown Ditch between Gerle Creek and the South Fork of the Rubicon River. The diversion structure is at a point on the creek where the stream bed elevation is about 5,220 feet. The water from Gerle Creek would flow in the Georgetown Ditch to the South Fork of the Rubicon River, and there the combined flows from Gerle Creek and from the South Fork would be diverted and conveyed westerly to discharge into Pilot Creek, upstream from Stumpy Meadows Reservoir. The point of diversion from the South Fork of the Rubicon River would be about 1,000 feet downstream from the existing diversion for the Georgetown Ditch. The stream bed elevation at the proposed diversion site is 5,145 feet. The diverted waters would flow in an enlarged, realigned Georgetown Ditch for a distance of 3.7 miles to the intake of the proposed Hartless Tunnel. Hartless Tunnel would extend about 2 miles in a southwesterly direction to Pilot Creek.

The proposed diversion structure on Onion Creek, a tributary to the South Fork of the American River, would be located at a site where the stream bed elevation is about 4,770 feet. The diverted water would be conveyed to Pilot Creek through a canal approximately 2 miles in length, and would discharge upstream from Stumpy Meadows Reservoir.

Releases of water from Stumpy Meadows Reservoir would be made into an enlarged Georgetown Ditch, and the water would flow for a distance of about 22 miles to the existing regulating basin located near Georgetown. Enlargement of the Georgetown Ditch below the regulating basin would also be required.

CARSON, LATROBE, AND PLACERVILLE SERVICE AREAS

These service areas, Nos. 20, 21, and 22 on Plate 16, have estimated ultimate mean seasonal water requirements of 74,800 acre-feet, 12,400 acre-feet, and 95,500 acre-feet, respectively, or a total of 182,700 acre-feet. They could be supplied with water to meet these requirements by a plan for multipurpose development of the upper reaches of the South Fork of the American River, and Webber, Sly Park, and Deer Creeks. The conserved waters would be conveyed through existing and proposed conduits to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 305,000 acre-feet. The installed power capacity of the hydroelectric power plants proposed would total about 206,000 kilowatts, and it is estimated that the plants would produce about 850,000,000 kilowatt-hours of electric energy seasonally.

The plan of development contemplates the construction of Alder Creek Dam and Reservoir on Alder Creek, a tributary of the South Fork of the American River. The stream bed elevation at the dam site is about 5,135 feet, and the storage capacity of the reservoir would be about 80,000 acre-feet. Water conserved in Alder Creek Reservoir would be augmented by water diverted from the Silver Fork, a tributary to the South Fork of the American River. The diversion from the Silver Fork would be made at a point where the stream bed elevation is about 5,530 feet. From this point the water would be conveyed westerly a distance of about 6 miles by canal and tunnel, and would discharge at the upstream end of Alder Creek Reservoir.

Water released from the reservoir would flow through a pipe line along the left bank of Alder Creek for a distance of about 3 miles to the proposed Alder Creek Power Plant. This plant would be located on Alder Creek at a site where the stream bed elevation is about 3,885 feet. The static head available to the plant would be approximately 1,450 feet, and the installed power capacity would be about 20,000 kilowatts. From the afterbay of the plant the released water would be conveyed a short distance in Alder Creek, and then discharged into the existing El Dorado Canal. The water would flow in the El Dorado Canal to serve a portion of the upper Placerville Service Area and the existing El Dorado Power Plant, located on the South Fork of the American River some 4 miles northwest of Pollock Pines. The water from Alder Creek would be substituted for water presently diverted into the El Dorado Canal from the South Fork of the American River, 3.5 miles upstream from Alder Creek.

The plan would also provide for diversion of water from the South Fork of the American River, and its conveyance to the proposed Junction Reservoir on Silver Creek. The diversion from the South Fork would be made about 3 miles east of Kyburz, at a point where the stream bed elevation is 4,843 feet. The water would be conveyed westerly a distance of about 15 miles through a proposed canal and tunnel to discharge into Junction Reservoir. Junction Dam would be located on Silver Creek about 6 miles northwest of Whitehall, where the stream bed elevation is 4,324 feet. The storage capacity of the reservoir would be about 317,000 acre-feet.

Water released from Junction Reservoir would flow in a tunnel a distance of about 4 miles to the proposed Junction Power Plant, to be located in a ravine 0.5 mile north of the South Fork of the American River. The elevation at the plant site is approximately 3,480 feet, and the static head available would be about 1,180 feet. The installed power capacity would be about 60,000 kilowatts.

From the afterbay of the Junction Power Plant, the water would be conveyed in a southwesterly direction through a proposed canal, a siphon under the South Fork of the American River, and then by tunnel to Sly Park Reservoir, recently constructed by the United States Bureau of Reclamation. The conduit would be approximately 6 miles in length.

Water conserved in Sly Park Reservoir is augmented by water diverted from Camp Creek, a tributary of the North Fork of the Cosumnes River, through a tunnel about 0.5 mile in length, and discharged directly into the upstream end of the reservoir. The stream bed elevation at Sly Park Dam is approximately 3,310 feet, and the storage capacity of the reservoir is about 40,000 acre-feet.

Under the plan of development, it is proposed that a hydroelectric power plant, with an installed power capacity of about 10,000 kilowatts, and an afterbay, be constructed below Sly Park Dam. The static head available to the plant would be approximately 140 feet. From the afterbay of the Sly Park Power Plant, the water would flow in a conduit a distance of about 8 miles to the forebay of the proposed Camino Power Plant, to be located on Webber Creek about 1 mile south of Camino. This conduit would supply water to a part of the upper portion of the Placerville Service Area. The stream bed elevation on Webber Creek at the site of the proposed power plant is approximately 2,340 feet. The installed power capacity of the plant would be about 45,000 kilowatts, and the static head available would be about 860 feet.

Water from the Camino Power Plant would discharge directly into the proposed enlarged Webber Creek Reservoir. The stream bed elevation of Webber Creek at the site of the dam, directly south of Camino, is about 2,186 feet. The storage capacity of the reservoir would be increased from the present 1,275 acre-feet to about 6,100 acre-feet. A power plant and afterbay would be constructed immediately downstream from Webber Creek Dam. The installed power capacity of the plant would be about 7,000 kilowatts, and the static head would be about 154 feet.

From the afterbay of the Webber Creek Power Plant, the water would be conveyed in a canal in a westerly direction a distance of about 8 miles, to the forebay of the proposed Placerville Power Plant. This plant would be located on Hangtown Creek, about 2 miles west of Placerville, at a site where the stream bed elevation is approximately 1,740 feet. The installed power capacity would be about 19,000 kilowatts, and the static head available to the plant would be about 360 feet. From the afterbay of this plant, two canals would be constructed, one extending westerly to supply water to the lower portions of the Placerville and Latrobe Service Areas, and to the proposed Deer Creek Reservoir, and the other canal extending generally northwesterly to the proposed Gold Hill Power Plant.

Deer Creek Dam would be located on Deer Creek, about 15 miles southwest of the Placerville Power Plant, at a site where the stream bed elevation is about 370 feet. The storage capacity of the reservoir would be approximately 30,000 acre-feet. Water released from Deer Creek Reservoir would serve a portion of the Carson Service Area. The remainder of this service area would be supplied water from a canal and pipe line extending from Folsom Reservoir. The conduit would extend southerly a distance of about 15 miles, and would divert from Folsom Reservoir at an elevation of about 330 feet.

The second canal extending from the forebay of the Placerville Power Plant would convey water a distance of about 6 miles to the forebay of the Gold Hill Power Plant. This plant would be located on the South Fork of the American River about 2 miles southeast of Coloma. The stream bed elevation of the South Fork at the plant site is approximately 845 feet. The installed power capacity of this plant would be about 45,000 kilowatts, and the static head available would be about 890 feet.

YOUNGS SERVICE AREA

This service area, No. 23 on Plate 16, has an estimated ultimate mean seasonal water requirement of 12,500 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve development of the waters of the North Fork of the Cosumnes River and certain of its tributaries, and their conveyance to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 19,600 acre-feet.

The plan contemplates construction of Capps Crossing Dam and Reservoir on the North Fork of the Cosumnes River. The dam would be located about 3.5 miles northeast of Dogtown at a site where the stream bed elevation is approximately 5,060 feet. The storage capacity of the reservoir would be about 19,200 acre-feet. Water released from the reservoir would be diverted immediately downstream from the dam and conveyed by canal along the left bank of the North Fork of the Cosumnes River for a distance of about 7 miles to the vicinity of Grizzly Flat.

The plan also contemplates the construction of Middle End Dam and Reservoir on the North Fork. The dam would be located about 2.5 miles north of Grizzly Flat at a site where the stream bed elevation is approximately 3,180 feet. The storage capacity of the reservoir would be about 7,000 acre-feet. Water released from the reservoir would be diverted at the dam and conveyed westerly and then southerly, crossing Steeley Ford to supply water to the service area. The total length of the canal would be about 7 miles.

AUKUM AND VOLCANO SERVICE AREAS

These service areas, Nos. 24 and 29 on Plate 16, have estimated ultimate mean seasonal water requirements of 19,000 acre-feet and 16,900 acre-feet, respectively, or a total of 35,900 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the Middle and South Forks of the Cosumnes River, and their conveyance to areas of use in these service areas. The estimated safe seasonal yield under this plan would be about 42,700 acre-feet.

The plan contemplates the construction of Pi Pi Dam and Reservoir on the Middle Fork of the Cosumnes River near West Falls. The stream bed elevation at the dam site is approximately 3,840 feet, and the storage capacity of the reservoir would be about 50,000 acre-feet. Water conserved in Pi Pi Reservoir would be augmented by waters diverted from the North Fork of the Middle Fork and from Middle Dry Creek, situated a short distance to the north of the reservoir, and conveyed to the reservoir. Water from Pi Pi Reservoir would be diverted from the Middle Fork immediately downstream from the dam and conveyed along the left bank in a canal for a distance of about 7 miles to Sopiago Reservoir on Sopiago Creek. At this point the water would be siphoned across Sopiago Creek to an existing ditch which extends west and south for a distance of about 5 miles. This ditch would be extended an additional 15 miles, crossing Scott Creek and the South Fork of the Cosumnes River. The ditch would supply water to higher lands situated in the Aukum and Volcano Service Areas. During the nonirrigation season releases from Pi Pi Reservoir would augment inflow to the proposed Sopiago and Case Valley Reservoirs.

Sopiago Dam on Sopiago Creek, a tributary of the Middle Fork of the Cosumnes River, would be located about 4 miles upstream from the confluence of the Middle Fork, where the stream bed elevation is approximately 3,520 feet. The storage capacity of the reservoir would be about 12,000 acre-feet. Releases from the reservoir would be diverted from Sopiago Creek 1 mile downstream from the dam and conveyed in a canal 5 miles in length to the vicinity of Omo Ranch. At this point water would be released from the canal to Cedar Creek for conveyance to irrigable lands situated south and west of Coyoteville. The canal would continue from Omo Ranch to supply water to irrigable lands west of Fairplay.

The plan also contemplates the construction of Case Valley Dam and Reservoir on the South Fork of the Cosumnes River, about 3 miles west of Dew Drop Fire Control Station. The dam would be located at a site where the stream bed elevation is approximately 3,220 feet. The storage capacity of the reservoir would be about 18,000 acre-feet. Releases from the reservoir would be diverted at the dam and conveyed in a canal about 5 miles in length to a point where a portion of the water supply would be spilled into Golden Gate Creek, a tributary of Sutter Creek. This water would be diverted downstream to supply irrigable lands in the vicinity of Volcano, Pine Grove, Mount Zion, and New York Ranch School. The remainder of the water from the point of spill would be conveyed by canal westerly to furnish water to lands north of Sutter Creek.

PLYMOUTH SERVICE AREA

This service area, No. 27 on Plate 16, has an estimated ultimate mean seasonal water requirement of 20,000 acre-feet. It could be supplied water to meet this requirement by a plan which would involve development of the water of the Middle and South Forks of the Cosumnes River, and their conveyance to areas of use through new and existing facilities. The safe seasonal yield under this plan would be about 25,000 acre-feet.

The plan contemplates construction of Bakers Ford Dam and Reservoir on the Middle Fork of the Cosumnes River near Bakers Ford. The stream bed elevation at the dam site is approximately 1,660 feet, and storage capacity of the reservoir would be about 16,000 acre-feet. The water released from the reservoir would be diverted from the Middle Fork at the dam and conveyed in a canal along the left bank of the river for a distance of approximately 13 miles to Shenandoah Valley.

Bridgeport Dam and Reservoir would be constructed on the South Fork of the Cosumnes River near Bridgeport. The stream bed elevation at the dam site is approximately 1,970 feet, and the storage capacity of the reservoir would be about 36,000 acre-feet. Water released from Bridgeport Reservoir would be diverted from the South Fork immediately downstream from the dam, and would be conveyed southerly in a canal approximately 8 miles in length to the vicinity of Fiddletown, supplying water to irrigable lands enroute.

LAGUNA AND IONE SERVICE AREAS

These service areas, Nos. 25 and 26 on Plate 16, have probable ultimate mean seasonal water requirements of 94,000 acre-feet and 77,100 acre-feet, respectively, or a total of 171,100 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the Cosumnes River at the Nashville site and from the proposed Folsom South Canal, hydroelectric power facilities, and conveyance of the conserved waters to areas of use in the respective service areas. The estimated safe seasonal yield of water under this plan would be about 177,000 acre-feet, of which 64,000 acre-feet would be supplied from the proposed Folsom South Canal. The installed power capacity of the proposed power plant would be about 10,000 kilowatts and the plant would produce about 40,000,000 kilowatt-hours of electrical energy seasonally.

The plan contemplates the construction of Nashville Dam and Reservoir on the Cosumnes River. The stream bed elevation at the dam site, located about 2 miles south of Nashville, is approximately 760 feet. The storage capacity of the reservoir would be about 550,000 acre-feet. A power plant with afterbay would be constructed immediately downstream from the dam. The static head available to the plant would be approximately 260 feet, and the installed hydroelectric power capacity would be about 10,000 kilowatts. From the afterbay of the Nashville Power Plant the water would flow in a canal in a southwesterly direction to supply irrigable lands in the Ione Service Area and a portion of the irrigable lands in the Laguna Service Area.

The remainder of the irrigable lands in the Laguna Service Area would be supplied with water from the proposed Folsom South Canal, which would extend from Lake Natoma on the American River southerly to Littlejohns Creek, a distance of approximately 50 miles. As planned, the Folsom South Canal would divert water at an elevation of about 118 feet and would extend southerly, crossing the Cosumnes River at an elevation of about 110 feet and Dry Creek at an elevation of about 100 feet. Water would be pumped from the canal between the Cosumnes River and Dry Creek to supply water to the remainder of the irrigable lands in the Laguna Service Area not furnished water from Nashville Reservoir. It is estimated that the maximum pumping lift from the canal would be on the order of 50 feet.

JACKSON SERVICE AREA

This service area, No. 28 on Plate 16, has an ultimate mean seasonal water requirement of 22,400 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve development of the waters of Sutter Creek, utilization of existing regulatory and conduit facilities, and conveyance of the conserved waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 23,000 acre-feet.

Water now used in a portion of the service area is obtained from the Mokelumne River through the Electra Tunnel and the Amador Canal. Water from the North Fork of the Mokelumne River is presently conveyed by the Electra Tunnel to Lake Tabeaud, which serves as the forebay to the existing Electra Power Plant of the Pacific Gas and Electric Company. This plant is located on the Mokelumne River, approximately 12 miles upstream from Pardee Reservoir of the East Bay Municipal Utility District. A portion of the water conveyed in the Electra Tunnel is pumped from Lake Tabeaud to the Amador Canal and conveyed in a northwesterly direction to Sutter Creek.

Under the plan of development, water in the Amador Canal would be released enroute to supply the southern portion of the Jackson Service Area. The remainder of the service area would be supplied from the proposed Volcano Reservoir. Volcano Dam would be constructed on Sutter Creek, about 2.5 miles west of the town of Volcano. The stream bed elevation at the dam site is approximately 1,730 feet, and storage capacity of the reservoir would be about 15,000 acre-feet. Water released from the reservoir would be diverted from Sutter Creek about 4 miles below the dam and conveyed westerly in a canal for a distance of about 7 miles to the Amador Canal near the town of Sutter Creek. From this point the Amador Canal would be enlarged and extended to the vicinity of Drytown. Water would be released enroute to supply irrigable lands situated below the canal.

ARROYO SECO SERVICE AREA

This service area, No. 31 on Plate 16, has an estimated ultimate mean seasonal water requirement of 35,000 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve development of the waters of Dry Creek, augmented with water from the previously described Folsom South Canal, and conveyance of the conserved waters to irrigable lands in the service area. The estimated mean seasonal yield under this plan would be about 35,000 acre-feet, of which 7,000 acre-feet would be supplied from the proposed Folsom South Canal. The plan contemplates construction of Irish Hill Dam and Reservoir on Dry Creek about 5.5 miles downstream from State Highway 49. The stream bed elevation at the dam site is approximately 400 feet, and the storage capacity of the reservoir would be about 28,000 acre-feet. The waters of Dry Creek conserved by the reservoir would be augmented by water diverted from Sutter Creek below the previously described Volcano Reservoir. Water from Irish Hill Reservoir would be diverted immediately below the dam and conveyed by canal in a southerly direction for a distance of about 10 miles, serving irrigable lands situated below the canal. Remaining irrigable lands in the Arroyo Seco Service Area not supplied from Irish Hill Reservoir would be furnished water from Ione Reservoir and the Folsom South Canal.

The plan would also involve construction of Ione Dam and Reservoir on Dry Creek. The stream bed elevation at the dam site, located about 1 mile west of the San Joaquin-Amador county line, is approximately 160 feet. The storage capacity of the reservoir would be about 50,000 acre-feet. Water of Dry Creek conserved by Ione Reservoir would be augmented by spill from Irish Hill Reservoir. Water released from Ione Reservoir would be diverted immediately downstream from the dam and conveyed by canal in a southerly direction for a distance of about 10 miles. Irrigable lands situated below the dam would be supplied water enroute. The remaining irrigable lands not supplied water from Irish Hill and Ione Reservoirs would be furnished water from the Folsom South Canal. The maximum pumping lift from the canal would be about 50 feet.

WEST POINT SERVICE AREA

This service area, No. 30 on Plate 16, has an estimated ultimate mean seasonal water requirement of 6,000 acre-feet. It could be supplied with water to meet this requirement by a plan which would involve development of the waters of Forest Creek and the Middle Fork of the Mokelumne River, and conveyance of these waters to irrigable lands within the service area. The estimated safe seasonal yield under this plan would be about 11,500 acre-feet.

The plan contemplates enlargement of existing Schaad (Middle Fork) Reservoir, which is located on the Middle Fork of the Mokelumne River. The stream bed elevation at the site of the dam is approximately 2,940 feet. The storage capacity of the reservoir would be increased from 1,870 acre-feet to about 10,000 acre-feet. Water conserved by the reservoir would be diverted at the dam and conveyed by two canals, one on either bank of the Middle Fork of the Mokelumne River, to the West Point and Mokelumne Service Areas. Each canal would be approximately 8 miles in length and would serve lands lying below an elevation of about 2,850 feet.

Forest Creek Dam and Reservoir would be located on Forest Creek near the Old Mattson Mill. The elevation of the stream bed at the dam site is approximately 3,250 feet, and the capacity of the reservoir would be about 5,000 acre-feet. Water conserved by this reservoir would be diverted at the dam and conveyed in a canal approximately 6 miles in length to lands situated at higher elevations in the West Point Service Area.

MOKELUMNE AND CALAVERAS SERVICE AREAS

These service areas, Nos. 34 and 35 on Plate 16, have estimated ultimate mean seasonal water requirements of 30,800 acre-feet and 30,700 acre-feet, respectively, or a total of 61,500 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the Middle and South Forks of the Mokelumne River, the North Fork of the Calaveras River, the North Fork of the Stanislaus River, hydroelectric power facilities, and conveyance of the conserved water to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 131,000 acre-feet, of which about 62,000 acre-feet would be supplied to the Mokelumne and Calaveras Service Areas. The installed power capacity of the proposed power plants would total about 29,000 kilowatts, and it is estimated that they would produce about 163,000,000 kilowatt-hours of electric energy seasonally.

The plan contemplates the seasonal diversion of about 2,000 acre-feet from Schaad Reservoir, previously described, to serve water to lands situated between the Middle and South Forks of the Mokelumne River. An additional 9,000 acre-feet would be diverted from the South Fork of the Mokelumne River, augmented by releases from Schaad Reservoir, under the existing right of the Calaveras Public Utility District, and would be conveyed in its canal to irrigate a portion of the lands lying below the canal. The remaining portion of the Mokelumne and Calaveras Service Areas would be supplied with water from developments on the North Fork of the Stanislaus River and Calaveras River.

Under the plan for the development of the North Fork of the Stanislaus River, an enlarged dam and reservoir would be constructed at the site of the existing Spicers Meadow Reservoir on Highland Creek, a tributary to the North Fork. The dam would be located about 2 miles south of the existing Union Dam at a point where the stream bed elevation is approximately 6,368 feet. The storage capacity of Spicers Meadow Reservoir would be increased from 3,800 acre-feet to about 38,000 acre-feet. Water released from the reservoir would be conveyed in a conduit along the right bank of Highland Creek for a distance of about 6 miles to the proposed Spicers Power Plant. This plant would be located on Highland Creek on the upstream end of the proposed Ganns Reservoir, at a site where the stream bed elevation is approximately 5,660 feet. The average static head available to the power plant would be about 700 feet, and the installed power capacity would be about 10,000 kilowatts.

Ganns Dam would be constructed about 1 mile downstream from the junction of the North Fork of the Stanislaus River and Highland Creek. The stream bed elevation at the dam site is about 5,470 feet, and the storage capacity of the reservoir would be about 15,000 acre-feet. Water conserved in Ganns Reservoir would be augmented by releases from Spicers Power Plant and releases from existing Utica Reservoir, and Silver Valley and Union Valley Reservoirs. Water released from the reservoir would flow down the natural channel to the proposed Ramsey Reservoir.

Ramsey Dam would be constructed on the North Fork of the Stanislaus River about 6 miles downstream from Ganns Dam. The stream bed elevation at the dam site is about 4,550 feet, and the storage capacity of the reservoir would be about 32,000 acre-feet. Water released from Ramsey Reservoir would be conveyed in a conduit, located along the right bank of the North Fork of the Stanislaus River, for a distance of about 12 miles, to the forebay of the proposed Moran Creek Power Plant, located on Moran Creek near White Pine. At this point the water would be conveyed in two directions. One would lead to the proposed Moran Creek Power Plant, subsequently described under Stanislaus, Rock Creek, and Bear Mountain Service Areas. The remaining water at the Moran Creek Power Plant forebay would be conveyed in a canal, located on the ridge between the Calaveras and Mokelumne River watersheds, to the penstock of the proposed Jesus Maria Creek Power Plant. This power plant would be located at a site where the stream bed elevation is about 3,200 feet. The static head available to the plant would be about 1,200 feet, and the installed hydroelectric power capacity would be about 7,000 kilowatts. A portion of releases from the power plant would flow down the creek to the proposed Jesus Maria Reservoir, while the remainder would be conveyed generally westerly in a canal for a distance of about 10 miles to augment water stored in the proposed enlarged McCarty Reservoir, located on the North Fork of the Calaveras River in Calaveras Valley. Water would be released from the canal to supply irrigable lands situated below the canal.

Jesus Maria Dam and Reservoir would be located on Jesus Maria Creek, about 3.5 miles northeast of Mountain Ranch. Stream bed elevation at the dam site is about 2,200 feet, and the storage capacity of the reservoir would be about 8,000 acre-feet. The reservoir would conserve the natural flow of the creek as well as water released from the previously described canal leading from Ramsey Reservoir. Water released from Jesus Maria Reservoir would be conveyed in a canal along the left bank of the creek for a distance of about 10 miles to supply water to irrigable lands in the Calaveras Service Area lying south of the creek and below an elevation of 2,100 feet.

McCarty Dam is located on the North Fork of the Calaveras River in Calaveras Valley, about 6 miles south of West Point. Stream bed elevation at the dam site is about 2,700 feet. The storage capacity of McCarty Reservoir would be increased from the present capacity of about 660 acre-feet to about 15,000 acre-feet. Water released from the reservoir would be diverted from the North Fork and conveyed in a canal, located along the ridge separating the watersheds of the South Fork of the Mokelumne River and the North Fork of the Calaveras River, for a distance of about 10 miles to the existing Mokelumne Ditch. This ditch presently serves a portion of the Mokelumne Service Area. The Mokelumne Ditch would be enlarged to supply water to the remainder of the irrigable lands in the Mokelumne Service Area.

BEAR CREEK AND HOGAN SERVICE AREAS

These service areas, Nos. 32 and 33 on Plate 16, have estimated ultimate mean seasonal water requirements of 74,900 acre-feet and 48,300 acre-feet, or a total of 123,200 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the Calaveras River, the North Fork of the Stanislaus River, import from the American River via the Folsom South Canal, and conveyance of the conserved waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 124,000 acre-feet. Hydroelectric power developments utilizing water from the Stanislaus River have been previously described under the Mokelumne and Calaveras Service Areas.

The plan contemplates construction of an enlarged Hogan Dam and Reservoir on the Calaveras River, about 6 miles southeast of San Andreas and about 8 miles east of the San Joaquin-Calaveras county line. Water conserved in Hogan Reservoir would include the flow of the Calaveras River, spill from proposed San Domingo Reservoir, described later herein, and spill from Jesus Maria and McCarty Reservoirs, located upstream in the watershed. Stream bed elevation at the site of Hogan Dam is about 530 feet, and the storage capacity of Hogan Reservoir would be increased from the present capacity of 76,000 acre-feet to about 325,000 acre-feet. Water released from Hogan Reservoir would be diverted from the Calaveras River and conveyed by canal to supply irrigable lands in the Hogan and Bear Creek Service Areas.

Under this plan, insufficient water would be made available from the works of the Calaveras and Stanislaus Rivers to meet the ultimate requirements of the Bear Creek and Hogan Service Areas. The most likely source of water supply to meet this deficiency would be from the American River by way of the Folsom South Canal. Water would be pumped from the canal and utilized in the lower reaches of the Bear Creek Service Area. It would be necessary to obtain about 19,000 acre-feet of water per season from this source to meet the remainder of the ultimate seasonal water requirements of the Bear Creek and Hogan Service Areas.

STANISLAUS, ROCK CREEK, AND BEAR MOUNTAIN SERVICE AREAS

These service areas, Nos. 36, 38, and 39 on Plate 16, have estimated ultimate mean seasonal water requirements of 25,800 acre-feet, 12,100 acre-feet, and 38,000 acre-feet, respectively, or a total of 75,900 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the North Fork of the Stanislaus River, of San Domingo and Angels Creeks, hydroelectric power facilities, and conveyance of the conserved waters to irrigable lands in the respective service areas. The estimated safe seasonal yield of this plan would be about 95,000 acre-feet, of which the major portion would be supplied from works described heretofore in the Mokelumne and Calaveras Service Areas. The installed power capacity of the proposed power plants would total about 12,000 kilowatts, and it is estimated they would produce about 84,000,000 kilowatt-hours of electrical energy seasonally. These totals are included in the total power capacity and energy output previously mentioned under the Mokelumne and Calaveras Service Areas.

As was described in the section dealing with the Mokelumne and Calaveras Service Areas, the plan for the Stanislaus, Rock Creek, and Bear Mountain Service Areas would in part include elements of works proposed for the conservation of waters of Highland Creek at the Spicers Meadow site, and the North Fork of the Stanislaus River at the Ganns and Ramsey sites. The waters so conserved would be conveyed to the forebay of the proposed Moran Creek Power Plant.

A portion of the water entering the forebay would be released to Moran Creek Power Plant, located on Moran Creek where the stream bed elevation is about 3,950 feet. The static head available to the plant would be about 550 feet, and the installed hydroelectric power capacity would be about 6,000 kilowatts. Releases from the power plant would be conveyed in Moran Creek downstream to the existing Hunter Reservoir and Utica Ditch, thence to the existing Murphys Power Plant, located about 1.5 miles northeast of Murphys on Angels Creek at stream bed elevation of 2,450 feet. The installed hydroelectric power capacity of the existing Murphys Power Plant, which operates under a constant head of 684 feet and has an installed hydroelectric power capacity of 3,800 kilowatts, would be increased to 7,000 kilowatts.

Water required to supply irrigable lands in the Stanislaus Service Area would be supplied for the most part from water discharged from the Murphys Power Plant. The water would be conveyed through existing and proposed canals extending southwesterly from the power plant. The lower portion of the Stanislaus Service Area would be served water from the proposed San Domingo-Bear Mountain Conduit, which in turn would be supplied water from the proposed San Domingo Reservoir. Water conserved by San Domingo Reservoir would be augmented by water released from the Murphys Power Plant. This water would be conveyed northwesterly in a proposed canal to the reservoir.

Releases from the Murphys Power Plant, to augment flow in San Domingo Reservoir, would be diverted from Angels Creek and conveyed northwesterly by canal a distance of about 3 miles to discharge into San Domingo Creek, a short distance upstream from San Domingo Reservoir. San Domingo Dam would be constructed on San Domingo Creek, about 1.5 miles northwest of Murphys, where the stream bed elevation is approximately 1,710 feet. The storage capacity of the reservoir would be about 22,000 acre-feet. Water released from the reservoir would be diverted immediately downstream from the dam and conveyed in a southwesterly direction by a canal and siphon along the southern boundary of the Calaveras River watershed and thence by tunnel through Bear Mountain, for a total distance of about 28 miles to a point near existing Salt Springs Valley Reservoir. Water from the San Domingo-Bear Mountain Conduit would serve irrigable lands in the lower portion of the Stanislaus Service Area and in the Bear Mountain Service Area. Irrigable lands in the Rock Creek Service Area would be supplied water from the existing Salt Springs Valley Reservoir, located about 5 miles east of Milton on Rock Creek. Stream bed elevation at Salt Springs Valley Dam is about 1,050 feet. Water conserved by the reservoir would be augmented by releases from the San Domingo-Bear Mountain Conduit.

LYONS, PHOENIX, AND KEYSTONE SERVICE AREAS

These service areas, Nos. 37, 40, and 41 on Plate 16, have estimated ultimate mean seasonal water requirements of 12,500 acre-feet, 35,900 acre-feet, and 25,500 acre-feet, respectively, or a total of 73,900 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the South Fork of the Stanislaus River, the North Fork of the Tuolumne River, upper Clavey, Lily, and Sullivan Creeks, hydroelectric power facilities, and conveyance of the conserved waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 120,000 acre-feet. The installed hydroelectric power capacity of the proposed power plant would be about 20,000 kilowatts, and it is estimated that it would produce about 94,000,000 kilowatt-hours of electric energy seasonally.

The plan contemplates the construction of Lily Lake Dam and Reservoir on Lily Creek, a tributary of the Tuolumne River. Stream bed elevation at the site of Lily Lake Dam is approximately 6,910 feet. The storage capacity of the reservoir would be about 9,000 acre-feet. Water released from the reservoir would be diverted at the dam and conveyed along the right bank of Lily Creek in a canal about 5 miles in length to the proposed Belle Meadows Reservoir located on Clavey Creek. Belle Meadows Dam on Clavey Creek, a tributary of the Tuolumne River, would be located at a site where the stream bed elevation is approximately 6,270 feet. The storage capacity of this reservoir would be about 10,000 acre-feet. Water released from Belle Meadows Reservoir would be diverted at the dam and conveyed in a canal about 2.5 miles in length, to spill into Trout Creek. The water of Trout Creek would be diverted a short distance downstream into a canal about 5 miles in length which would spill into the proposed Lords Reservoir located on Rush Creek.

Lords Dam, located on Rush Creek, a tributary of Clavey Creek and the Tuolumne River, would be located at a site where the stream bed elevation is approximately 5,325 feet. Lords Reservoir would have a storage capacity of 10,000 acre-feet. Water released from this reservoir would be diverted at the dam and conveyed along the right bank of Rush Creek in a canal about 8 miles in length, to spill into the proposed Browns Meadow Reservoir, located on the North Fork of the Tuolumne River. Browns Meadow Dam would be located approximately 2 miles east of Long Barn, where the stream bed elevation is about 4,665 feet. The storage capacity of the reservoir would be about 14,000 acre-feet. Releases from Browns Meadow Reservoir would be diverted at the dam and conveyed in a canal about 4.5 miles in length to a tunnel 0.75 mile in length, discharging into the proposed enlarged Lyons Reservoir, located on the South Fork of the Stanislaus River about 2 miles northwest of Long Barn.

Existing Lyons Reservoir supplies water to the existing Phoenix Power Plant through the Tuolumne Ditch. Stream bed elevation at Lyons Dam is approximately 4,100 feet. The storage capacity of Lyons Reservoir would be increased from the present 5,500 acre-feet to about 63,000 acre-feet. Water released from the reservoir would be conveyed in the existing Tuolumne Ditch system to supply water to irrigable lands in the Lyons Service Area, and to augment water conserved by the proposed enlarged Phoenix Reservoir.

Phoenix Dam is located on Sullivan Creek about 3 miles northeast of Sonora, at a site where the stream bed elevation is about 2,355 feet. The storage capacity of this reservoir would be increased from the present 850 acre-feet to about 25,000 acre-feet. Water conserved in the enlarged reservoir would be augmented by increased releases of water from the proposed enlarged Phoenix Power Plant, located about 2 miles north of Phoenix Dam. The installed hydroelectric power capacity of the power plant would be increased from 1,800 kilowatts to about 20,000 kilowatts. Irrigable lands in the Phoenix and Keystone Service Areas would be served water from the enlarged Phoenix Reservoir through existing and proposed canals.

BLANCHARD, GROVELAND, HARDIN, AND BAXTER SERVICE AREAS

These service areas, Nos. 42, 43, 44, and 45 on Plate 16, have estimated ultimate mean seasonal water requirements of 9,500 acre-feet, 19,200 acre-feet, 11,400 acre-feet, and 17,700 acre-feet, respectively, or a total of 57,800 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the Middle and South Forks of the Tuolumne River and conveyance of the conserved water to irrigable lands in the respective service areas. The estimated safe seasonal yield of this plan would be about 58,000 acre-feet.

The plan contemplates construction of Cottonwood Meadows Dam and Reservoir on the Middle Fork of the Tuolumne River, just below the confluence of Cottonwood Creek. Stream bed elevation at the dam site is about 5,875 feet. The storage capacity of the reservoir would be about 30,000 acre-feet. Releases from the reservoir would be diverted from the river at a point about 3 miles downstream from the dam. Stream bed elevation at the site of the proposed diversion is approximately 4,800 feet. The diverted water would be conveyed in a canal in a southwesterly direction a distance of about 4 miles to a point on the South Fork upstream from the proposed Hardin Flat Reservoir.

Hardin Flat Dam would be constructed at a site on the South Fork of the Tuolumne River near Hardin Ranch, where the stream bed elevation is approximately 3,460 feet. The storage capacity of the reservoir would be about 40,000 acre-feet. Water conserved by the reservoir would be released to the existing but improved Groveland Ditch, and conveyed to irrigable lands in the Groveland Service Area. About 10 miles below Hardin Flat Dam water would be diverted from the Groveland Ditch and conveyed southwesterly through proposed canals to serve water to irrigable lands in the Hardin, Blanchard, and Baxter Service Areas.

HORNITOS, MARIPOSA, WHITE ROCK, AND CHOWCHILLA SERVICE AREAS

These service areas, Nos. 46, 47, 48, and 49 on Plate 16, have estimated ultimate mean seasonal water requirements of 35,800 acre-feet, 8,600 acre-feet, 10,100 acre-feet, and 26,100 acre-feet, respectively, or a total of 80,600 acre-feet. They could be supplied with water to meet these requirements by a plan which would involve development of the waters of the South Fork of the Merced River, tributaries of the West Fork of the Chowchilla River and of Mariposa and Bear Creeks, hydroelectric power facilities, and conveyance of the conserved waters to irrigable lands in the respective areas. The estimated safe seasonal yield under this plan would be about 100,000 acre-feet. The total installed hydroelectric power capacity would be 12,000 kilowatts, and it is estimated that the energy generated would be about 53,000,000 kilowatts seasonally.

The plan contemplates construction of Wawona Dam and Reservoir on the South Fork of the Merced River. Wawona Dam would be located at a site where the stream bed elevation is approximately 3,900 feet. The reservoir would have a storage capacity of about 5,000 acre-feet and would serve only as a diversion structure. It would not inundate any of the existing facilities of the Yosemite National Park. Water diverted at the dam would be conveyed westerly in the proposed Wawona-Snow Creek Conduit, consisting of a tunnel 4.5 miles in length, a canal 6.5 miles in length, and 1 mile of inverted siphon. The conduit would terminate at the proposed Snow Creek Reservoir, located on Snow Creek.

Snow Creek Dam would be located at a site where the stream bed elevation is approximately 3,400 feet. This site is about 1 mile northwest of Buckingham Mountain School. The storage capacity of Snow Creek Reservoir would be about 60,000 acre-feet. Releases would be made from the Wawona-Snow Creek Conduit and from Snow Creek Reservoir to supply water to lands in the upper Chowchilla Service Area. Most of the water released from Snow Creek Reservoir would be conveyed by a canal 1.5 miles in length to the inlet of a penstock leading to the proposed Snow Creek Power Plant. The inlet to the penstock would be located about 1.5 miles west of Buckingham Mountain School. From this inlet a canal would convey a portion of the water to irrigable lands in the upper Mariposa and Chowchilla Service Areas. The remainder of the flow would pass through the penstock to the Snow Creek Power Plant. The static head available to the plant would be about 900 feet. The installed hydroelectric power capacity would be 12,000 kilowatts, and it is estimated that the plant would generate about 53,000,000 kilowatt-hours seasonally.

From the afterbay of the Snow Creek Power Plant water would be diverted and conveyed in a canal 6 miles in length to a point located about 2 miles east of Mormon Bar. At this point releases would be made to the proposed Humbug Reservoir on Humbug Creek, proposed Striped Rock Reservoir on Striped Rock Creek, proposed Agua Fria Reservoir on Mariposa Creek, and to a canal about 15 miles in length which would convey water westerly to supply irrigable lands in the Mariposa Service Area in the vicinity of Mariposa, Mount Bullion, and Bear Valley. The canal would also supply water to augment inflow to the proposed Bear Creek Reservoir located on Bear Creek.

Humbug Dam and Reservoir would be located on Humbug Creek, about 4 miles southeast of Mormon Bar. Stream bed elevation at the site of the dam is approximately 1,740 feet. The storage capacity of the reservoir would be about 5,000 acre-feet. Releases from the reservoir would be made to supply lands in the lower Chowchilla Service Area.

Striped Rock Dam and Reservoir on Striped Rock Creek would be constructed at a site located about 2 miles east of Ben Hur. Stream bed elevation at the site of the proposed dam is approximately 1,340 feet. Storage capacity of the reservoir would be about 5,000 acre-feet. Water would be released from the reservoir to a proposed canal which would be about 5 miles in length and which would supply water to the remaining irrigable lands in the Chowchilla Service Area.

Agua Fria Dam and Reservoir on Mariposa Creek would be constructed just downstream from the confluence with Agua Fria Creek. Stream bed elevation at the site of the proposed dam is approximately 1,320 feet. The storage capacity of the reservoir would be about 15,000 acre-feet. Water released from the reservoir would be conveyed in a proposed canal about 10 miles in length to supply water to the White Rock Service Area.

Bear Creek Dam and Reservoir would be constructed on Bear Creek at a site located about 5 miles south of the town of Bear Valley. Stream bed elevation at the site of the proposed dam is approximately 1,615 feet. The storage capacity of the reservoir would be about 22,000 acre-feet. Water released from the reservoir would be conveyed by canals to supply irrigable lands in the Hornitos Service Area.

CHAPTER V

SUMMARY OF CONCLUSIONS, AND RECOMMENDATIONS

On the basis of field investigations and studies and analyses of available data concerning the water resources of the Mother Lode Region, the following conclusions have been reached and recommendations made.

SUMMARY OF CONCLUSIONS

It is concluded that:

1. The basic industries in which the present economy of the Mother Lode Region is founded are lumbering, agriculture, recreation, and mining. The greatest opportunity for economic expansion appears to be in the field of agriculture.

2. Streams tributary to the Mother Lode Region produce a mean seasonal runoff of about 17,000,000 acre-feet, almost 25 per cent of the total surface runoff of California. This runoff is, and must continue to be, the primary source of water supply for all purposes in the region.

3. There are no ground water basins of significant extent and potential yield in the Mother Lode Region, and ground water is not a primary source of water supply, except for local domestic and stockwatering purposes. In limited areas in the extreme western portion of the region, bordering the ground water basin of the Central Valley, some ground water is used for irrigation. However, the extensive development of ground water for irrigation use in the region as a whole is not practicable.

4. The surface water supplies of the Mother Lode Region are of excellent mineral quality, for both domestic and irrigation use.

5. Present development of the water resources of the Mother Lode Region for use within the region is meager, and substantial expansion of the local economy cannot be accomplished until new water supplies are developed. Development of the water resources for use in areas outside the region is substantial, especially in the southern part of the region. Agencies of these outside areas plan increased development of water supplies within the Mother Lode Region.

6. At present there are approximately 63,000 acres of irrigated land and 57,000 acres of dry-farmed land in the Mother Lode Region. About 85 per cent of the irrigated land is in the northern half of the region, and more than half of this land is in Placer County.

7. The ultimate land-use pattern in the Mother Lode Region should include a maximum irrigated area of about 650,000 acres, or about 10 times the present acreage irrigated. This conclusion is based on the assumption that all lands in the region physically suited for irrigation will ultimately be brought under irrigation.

8. The principal irigated crops in the Mother Lode Region today are deciduous orchards, irrigated pasture, and olives. This general pattern should generally prevail in the future, with irrigated pasture becoming relatively more important than it is today, and with the additional irrigation of hay and grain.

9. Of the total quantity of applied water consumed for all purposes in the Mother Lode Region today, more than 80 per cent is used for irrigation. The mean seasonal consumptive use of applied water totals about 124,000 acre-feet, or less than one per cent of the surface water resources of the region. More than 80 per cent of the consumption of applied water occurs in the northern half of the region.

10. Under conditions of ultimate development the mean seasonal consumptive use of applied water for all purposes in the Mother Lode Region should be nearly 1,180,000 acre-feet, more than 90 per cent of which should be for irrigation. The quantity is more than nine times the present use, and is equivalent to about seven per cent of the surface water supplies of the region.

11. Under conditions of ultimate development the seasonal application of water in the agricultural zone of the Mother Lode Region should average nearly 2,100,000 acre-feet, more than 90 per cent of which should be for irrigation. A substantial portion of the applied water that is not consumptively used will return to streams of the Mother Lode Region and be available for re-use.

12. Under conditions of ultimate development the mean seasonal water requirement in the agricultural zone of the Mother Lode Region, measured in terms of consumptive use of applied water plus irrecoverable losses, should be about 1,540,000 acre-feet.

13. Taken as a whole, the water resources of the Mother Lode Region far exceed its probable ultimate water requirements.

14. The plans for development described herein to supply water for the agricultural zone in the Mother Lode Region include consideration of the construction of 46 proposed dams and reservoirs and 21 power houses, and the enlargement of 12 existing reservoirs and 8 power plants. Reservoir storage capacity in the region would be increased by 3,500,000 acre-feet, and the installed hydroelectric power capacity by 680,000 kilowatts. Total increase in hydroelectric energy pro-

duction in the region would amount to about 2,900,000,000 kilowatt-hours seasonally. The total safe seasonal yield would be about 3,360,000 acre-feet, to meet the total ultimate mean seasonal water requirement of the agricultural zone in the region of 1,540,000 acre-feet.

15. The Deer Creek, Chico, Magalia, and Big Bend Service Areas, with an estimated ultimate mean seasonal water requirement of 47,500 acre-feet, could be supplied with water to meet this requirement by a plan which would involve the construction of dams and reservoirs on Butte and Little Butte Creeks, and utilization and enlargement of certain existing works in and adjacent to the areas. The estimated safe seasonal yield under the plan would be about 105,000 acre-feet.

16. The Buckeye Service Area, with an estimated ultimate mean seasonal water requirement of 8,000 acre-feet, could be supplied with water to meet this requirement by a plan which would involve the construction of a dam and reservoir on the upper reaches of the Little North Fork of the Feather River, diversion of the conserved water through a tunnel to Peavine Creek, rediversion of the flows from Peavine Creek, and their conveyance by canal to areas of use. The estimated safe seasonal yield under this plan would be about 10,000 acre-feet.

17. The Bidwell Service Area, with an estimated ultimate mean seasonal water requirement of 6,900 acre-feet, could be supplied with water to meet this requirement by a plan which would involve the construction of a dam and reservoir on upper Fall River, and conveyance of the conserved water to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 8,500 acre-feet.

18. The Wyandotte, Challenge, Strawberry, and Browns Valley Service Areas, with an estimated ultimate mean seasonal water requirement of 146,600 acre-feet, could be supplied with water to meet this requirement by a plan for multipurpose development of the South Fork of the Feather River and adjacent streams, and conveyance of the conserved water to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 185,000 acre-feet. The installed hydroelectric power capacity would total about 98,500 kilowatts, and it is estimated that the power plants would produce about 327,000,000 kilowatt-hours seasonally.

19. The Tyler and Grass Valley Service Areas, with an estimated ultimate mean seasonal water requirement of 96,900 acre-feet, could be supplied with water to meet this requirement by a plan which would involve conservation of the waters of the South Fork of the Yuba River and Deer Creek, and conveyance of the conserved waters to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 225,000 acre-feet. The installed hydroelectric power capacity would total about 64,300 kilowatts, and it is estimated that the power plant would produce about 237,000,000 kilowatt-hours of electric energy seasonally.

20. The Smartville Service Area, with an estimated ultimate mean seasonal water requirement of 11,700 acre-feet, could be supplied with water to meet this requirement by a plan which would involved the diversion and conveyance of water from the Yuba River to the service area. The safe seasonal yield under this plan would be about 300,000 acre-feet.

21. The Spaulding Service Area, with an estimated ultimate mean seasonal water requirement of 4,800 acre-feet, could be supplied with water to meet this requirement by a plan which would involve the conveyance of water from the afterbay of the Deer Creek Power Plant to the service area. The estimated safe seasonal yield under this plan would be about 4,800 acre-feet.

22. The Doty, Colfax, and Loomis Service Areas, with an estimated ultimate mean seasonal water requirement of 200,800 acre-feet, could be supplied with water to meet this requirement by a plan which would involve developments on the Yuba, Bear, and American Rivers, and conveyance of the waters to the respective service areas. The safe seasonal yield under this plan would be about 1,200,000 acre-feet. The increase in installed hydroelectric power capacity would be about 244,000 kilowatts, and about 765,000,000 kilowatt-hours of new electric energy would be produced seasonally.

23. The Foresthill Service Area, with an estimated ultimate mean seasonal water requirement of 24,000 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of minor streams lying between the North and Middle Forks of the American River, and conveyance of the waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 24,700 acre-feet.

24. The Georgetown Service Area, with an estimated ultimate mean seasonal water requirement of 27,400 acre-feet, could be supplied with water to meet this requirement by a plan which would involve construction of a dam and reservoir on Pilot Creek, and augmentation of the conserved water by diversions from Gerle Creek, South Fork of the Rubicon River, and Onion Creek. Existing conduits would be improved and enlarged to convey the water to the service area. The estimated safe seasonal yield under this plan would be about 38,600 acre-feet.

25. The Carson, Latrobe, and Placerville Service Areas, with an estimated ultimate mean seasonal water requirement of 182,700 acre-feet, could be supplied with water to meet this requirement by a plan for multipurpose development of the upper reaches of the South Fork of the American River, and Webber, Sly Park, and Deer Creeks. The waters would be

conveyed to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 305,000 acre-feet. The installed hydroelectric power capacity of the power plants proposed would total about 206,000 kilowatts, and it is estimated that the plants would produce about 850,000,000 kilowatt-hours of electric energy seasonally.

26. The Youngs Service Area, with an estimated ultimate mean seasonal water requirement of 12,500 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the North Fork of the Cosumnes River and certain of its tributaries, and conveyance of these waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 19,600 acre-feet.

27. The Aukum and Volcano Service Areas, with an estimated ultimate mean seasonal water requirement of 35,900 acre-feet, could be supplied with water to meet this requirement by a plan which would involve the development of the waters of the Middle and South Forks of the Cosumnes River, and their conveyance to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 42,700 acre-feet.

28. The Plymouth Service Area, with an estimated ultimate mean seasonal water requirement of 20,000 acre-feet, could be supplied water to meet this requirement by a plan which would involve the development of waters of the Middle and South Forks of the Cosumnes River, and their conveyance to areas of use through new and existing facilities. The estimated safe seasonal yield under this plan would be about 25,000 acre-feet.

29. The Laguna and Ione Service Areas, with an estimated ultimate mean seasonal water requirement of 171,100 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of waters of the Cosumnes River, water from the proposed Folsom South Canal, hydroelectric power facilities, and conveyance of the waters to areas of use in the respective service areas. The estimated safe seasonal yield under this plan would be about 177,000 acre-feet. The installed capacity of the proposed power plant would be about 10,000 kilowatts, and the plant would produce about 40,000,000 kilowatt-hours of electric energy seasonally.

30. The Jackson Service Area, with an estimated ultimate mean seasonal water requirement of 22,400 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of Sutter Creek, utilization of existing facilities, and conveyance of the waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 23,000 acre-feet.

31. The Arroyo Seco Service Area, with an estimated ultimate mean seasonal water requirement of 35,000 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of Dry Creek, augmented with water from the proposed Folsom South Canal, and conveyance of the waters to the service area. The estimated safe seasonal yield under this plan would be about 35,000 acre-feet.

32. The West Point Service Area, with an estimated ultimate mean seasonal water requirement of 6,000 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of Forest Creek and the Middle Fork of the Mokelumne River, and conveyance of the waters to areas of use in the service area. The estimated safe seasonal yield under this plan would be about 11,500 acre-feet.

33. The Mokelumne and Calaveras Service Areas, with an estimated ultimate mean seasonal water requirement of 61,500 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the Middle and South Forks of the Mokelumne River, the North Fork of the Calaveras River, the North Fork of the Stanislaus River, hydroelectric power facilities, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 131,000 acre-feet, of which 62,000 acre-feet would be utilized in the Mokelumne and Calaveras Service Areas. The installed power capacity of the proposed power plants would total about 29,000 kilowatts, and it is estimated that the plants would produce about 163,000,000 kilowatt-hours seasonally.

34. The Bear Creek and Hogan Service Areas, with an estimated ultimate mean seasonal water requirement of 123,200 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the Calaveras River, the North Fork of the Stanislaus River, import from the American River via the Folsom South Canal, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 124,000 acre-feet.

35. The Stanislaus, Rock Creek, and Bear Mountain Service Areas, with an estimated ultimate mean seasonal water requirement of 75,900 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the North Fork of the Stanislaus River, San Domingo and Angels Creeks, hydroelectric power facilities described in connection with plans for the Mokelumne and Calaveras Service Areas, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 95,000 acre-feet. The installed power capacity of the proposed hydro-

electric power plants would be 12,000 kilowatts, and it is estimated that they would produce about 84,000,000 kilowatt-hours seasonally. These totals are included in the total power capacity and energy output mentioned previously under the Calaveras and Mokelumne Service Areas.

36. The Lyons, Phoenix, and Keystone Service Areas, with an estimated ultimate mean seasonal water requirement of 73,900 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the South Fork of the Stanislaus River, the North Fork of the Tuolumne River, upper Clavey, Lily, and Sullivan Creeks, hydroelectric power facilities, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 120,000 acre-feet. The installed power capacity of the proposed hydroelectric power plant would be about 20,000 kilowatts, and it is estimated that the plant would produce about 94,000,000 kilowatt-hours seasonally.

37. The Blanchard, Groveland, Hardin, and Baxter Service Areas, with an estimated ultimate mean seasonal water requirement of 57,800 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the Middle and South Forks of the Tuolumne River, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 58,000 acre-feet.

38. The Hornitos, Mariposa, White Rock, and Chowchilla Service Areas, with an estimated ultimate mean seasonal water requirement of 80,600 acre-feet, could be supplied with water to meet this requirement by a plan which would involve development of the waters of the South Fork of the Merced River, tributaries of the West Fork of the Chowchilla River and of Mariposa and Bear Creeks, hydroelectric power facilities, and conveyance of the waters to irrigable lands in the respective service areas. The estimated safe seasonal yield under this plan would be about 100,000 acre-feet. The total installed hydroelectric power capacity would be 12,000 kilowatts, and it is estimated that the energy generated would be about 53,000,000 kilowatt-hours seasonally.

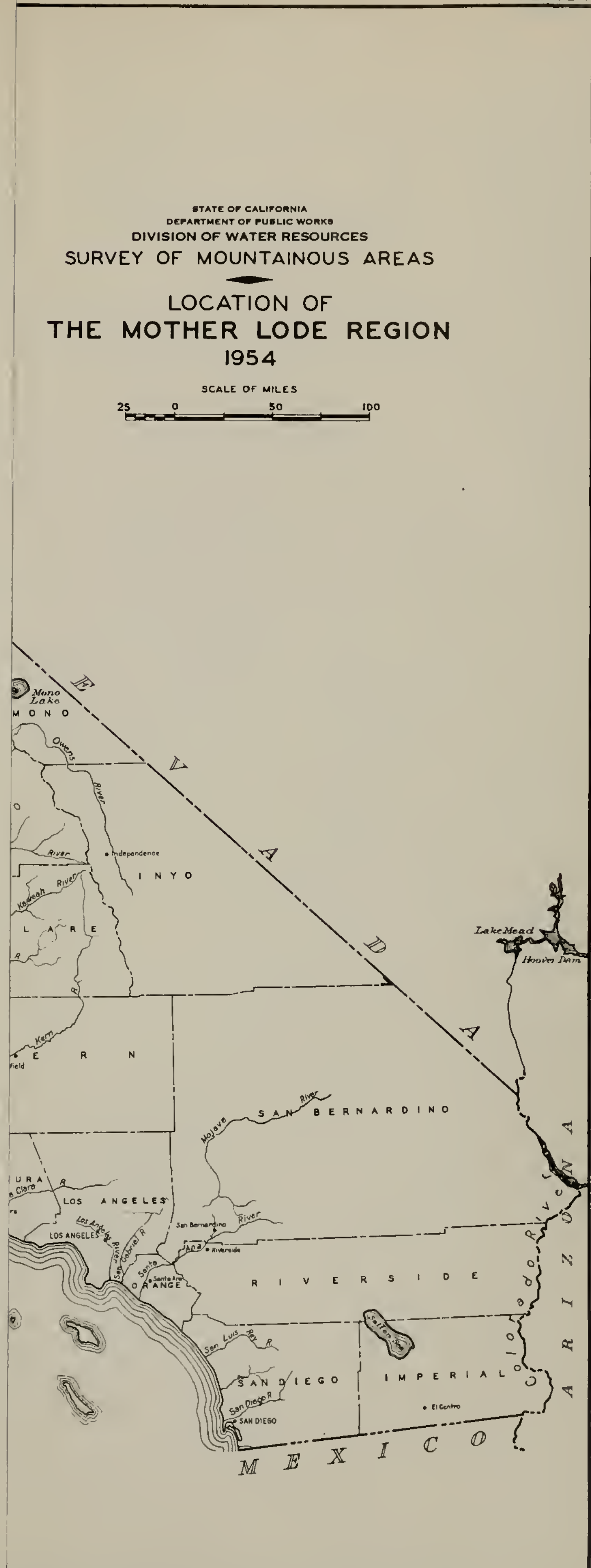
RECOMMENDATIONS

It is recommended that:

1. In areas where they do not now exist, public districts endowed with appropriate powers be created for the purposes of proceeding with further study of local water problems, and with the financing, construction, and operation of projects considered necessary and financially sound.

2. Continued support be given to the investigation and development of The California Water Plan, from which the Mother Lode Region can derive direct benefits.

3. Local development of water resources be accomplished in accordance with The California Water Plan.


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
LOCATION OF
THE MOTHER LODE REGION
1954
SCALE OF MILES
25 0 50 100
Mono Lake
MONO
Owens River
Independence
INYO
Kaweah River
Kern
SAN BERNARDINO
Mojave River
Lake Mead
Hoover Dam
LOS ANGELES
San Bernardino
Riverside
Santa Ana
ORANGE
RIVERSIDE
San Luis Rey R
SAN DIEGO
San Diego R
IMPERIAL
El Centro
Salton Sea
Colorado River
NEVADA
ARIZONA
MEXICO

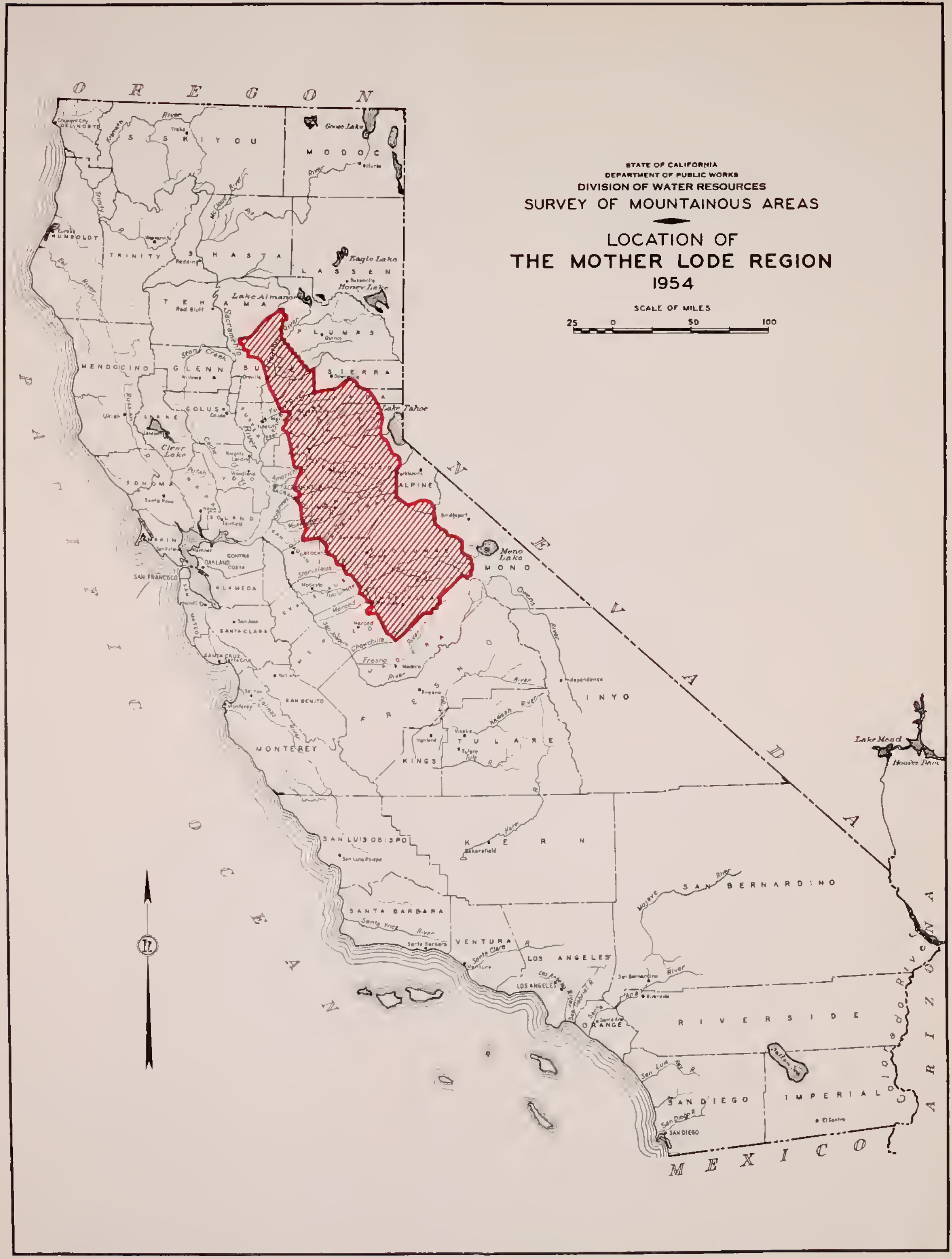
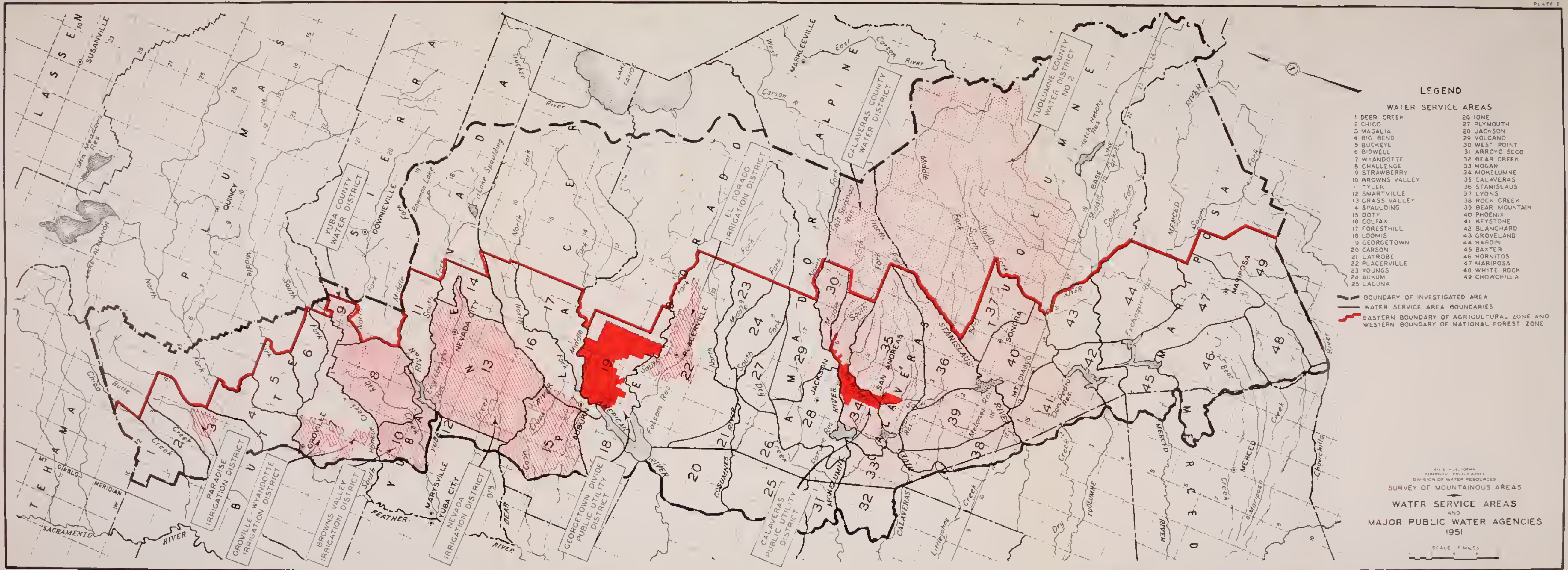

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
LOCATION OF
THE MOTHER LODE REGION
1954
SCALE OF MILES
25 0 50 100
O R E G O N
N E V A D A
A R I Z O N A
M E X I C O
P A C I F I C
O C E A N
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
SIERRA
MENDOCINO
GLENN
BUTTE
COLUSA
LAKE
YOLO
SONOMA
SOLANO
ALPINE
MONO
ALAMEDA
SANTA CLARA
SAN BENITO
MONTEREY
FRESNO
TULARE
KINGS
INYO
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
Goose Lake
Eagle Lake
Honey Lake
Lake Almanor
Lake Tahoe
Clear Lake
Mono Lake
Lake Mead
Hoover Dam
SAN FRANCISCO
OAKLAND
LOS ANGELES
SAN DIEGO

PLATE 2


LEGEND
WATER SERVICE AREAS
1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
11 TYLER
12 SMARTVILLE
13 GRASS VALLEY
14 SPAULDING
15 DOTY
16 COLFAX
17 FORESTHILL
18 LOOMIS
19 GEORGETOWN
20 CARSON
21 LATROBE
22 PLACERVILLE
23 YOUNGS
24 AUKUM
25 LAGUNA
26 IONE
27 PLYMOUTH
28 JACKSON
29 VOLCANO
30 WEST POINT
31 ARROYO SECO
32 BEAR CREEK
33 HOGAN
34 MOKELUMNE
35 CALAVERAS
36 STANISLAUS
37 LYONS
38 ROCK CREEK
39 BEAR MOUNTAIN
40 PHOENIX
41 KEYSTONE
42 BLANCHARD
43 GROVELAND
44 HARDIN
45 BAXTER
46 HORNITOS
47 MARIPOSA
48 WHITE ROCK
49 CHOWCHILLA
BOUNDARY OF INVESTIGATED AREA
WATER SERVICE AREA BOUNDARIES
EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
WATER SERVICE AREAS
AND
MAJOR PUBLIC WATER AGENCIES
1951
PARADISE IRRIGATION DISTRICT
OROVILLE - WYANDOTTE IRRIGATION DISTRICT
BROWNS VALLEY IRRIGATION DISTRICT
NEVADA IRRIGATION DISTRICT
GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT
CALAVERAS PUBLIC UTILITY DISTRICT
YUBA COUNTY WATER DISTRICT
EL DORADO IRRIGATION DISTRICT
CALAVERAS COUNTY WATER DISTRICT
TUOLUMNE COUNTY WATER DISTRICT NO 2
LASSEN
PLUMAS
SIERRA
NEVADA
PLACER
EL DORADO
ALPINE
AMADOR
CALAVERAS
TUOLUMNE
MARIPOSA
MERCED
BUTTE
YUBA
TEHAMA
SUSANVILLE
QUINCY
DOWNIEVILLE
MARKLEEVILLE
OROVILLE
MARYSVILLE
YUBA CITY
NEVADA CITY
AUBURN
PLACERVILLE
JACKSON
SAN ANDREAS
SONORA
MARIPOSA
MERCED
LAKE TAHOE
SACRAMENTO RIVER
FEATHER RIVER
BEAR RIVER
AMERICAN RIVER
COSUMNES RIVER
MOKELUMNE RIVER
CALAVERAS RIVER
STANISLAUS RIVER
TUOLUMNE RIVER
MERCED RIVER
MT DIABLO MERIDIAN

LEGEND

WATER SERVICE AREAS

1 DEER CREEK	26 IONE
2 CHICO	27 PLYMOUTH
3 MAGALIA	28 JACKSON
4 BIG BEND	29 VOLCANO
5 BUCKEYE	30 WEST POINT
6 BIDWELL	31 ARROYO SECO
7 WYANDOTTE	32 BEAR CREEK
8 CHALLENGE	33 HOGAN
9 STRAWBERRY	34 MOKELUMNE
10 BROWNS VALLEY	35 CALAVERAS
11 TYLER	36 STANISLAUS
12 SMARTVILLE	37 LYONS
13 GRASS VALLEY	38 ROCK CREEK
14 SPAULDING	39 BEAR MOUNTAIN
15 DOTY	40 PHOENIX
16 COLFAX	41 KEYSTONE
17 FORESTHILL	42 BLANCHARD
18 LOOMIS	43 GROVELAND
19 GEORGETOWN	44 HARDIN
20 CARSON	45 BAXTER
21 LATROBE	46 HORNITOS
22 PLACERVILLE	47 MARIPOSA
23 YOUNGS	48 WHITE ROCK
24 AUKUM	49 CHOWCHILLA
25 LAGUNA	

BOUNDARY OF INVESTIGATED AREA

WATER SERVICE AREA BOUNDARIES

EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE

AIKEN SERIES-GROUP	HOLLAND SERIES-GROUP
AUBURN SERIES-GROUP	LAVA
GOLDBRIDGE - VALLECITOS SERIES-GROUP	LIMESTONE
HUGO-AUBURN COMPLEX SERIES-GROUP	MONTARA SERIES-GROUP
HUGO SERIES-GROUP	SECONDARY SOILS OLD TO RECENT ALLUVIUM

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SURVEY OF MOUNTAINOUS AREAS

SOILS OF THE MOTHER LODE REGION IN THE AGRICULTURAL ZONE

SCALE OF MILES

4 0 4 8 12

LEGEND

WATER SERVICE AREAS

1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
11 TYLER
12 SMARTVILLE
13 GRASS VALLEY
14 SPAULDING
15 DOTY
16 COLFAX
17 FORESTHILL
18 LOOMIS
19 GEORGETOWN
20 CARSON
21 LATROBE
22 PLACERVILLE
23 YOUNGS
24 AUKUM
25 LAGUNA
26 IONE
27 PLYMOUTH
28 JACKSON
29 VOLCANO
30 WEST POINT
31 ARROYO SECO
32 BEAR CREEK
33 HOGAN
34 MOKELUMNE
35 CALAVERAS
36 STANISLAUS
37 LYONS
38 ROCK CREEK
39 BEAR MOUNTAIN
40 PHOENIX
41 KEYSTONE
42 BLANCHARD
43 GROVELAND
44 HARDIN
45 BAXTER
46 HORNITOS
47 MARIPOSA
48 WHITE ROCK
49 CHOWCHILLA

BOUNDARY OF INVESTIGATED AREA

WATER SERVICE AREA BOUNDARIES

EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE

AIKEN SERIES - GROUP

AUBURN SERIES - GROUP

GOLDBRIDGE - VALLECITOS SERIES - GROUP

HUGO - AUBURN COMPLEX SERIES - GROUP

HUGO SERIES - GROUP

HOLLAND SERIES - GROUP

LAVA

LIMESTONE

MONTARA SERIES - GROUP

SECONDARY SOILS OLD TO RECENT ALLUVIUM

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SURVEY OF MOUNTAINOUS AREAS

SOILS OF THE MOTHER LODE REGION IN THE AGRICULTURAL ZONE

SCALE OF MILES

4 0 4 8 12

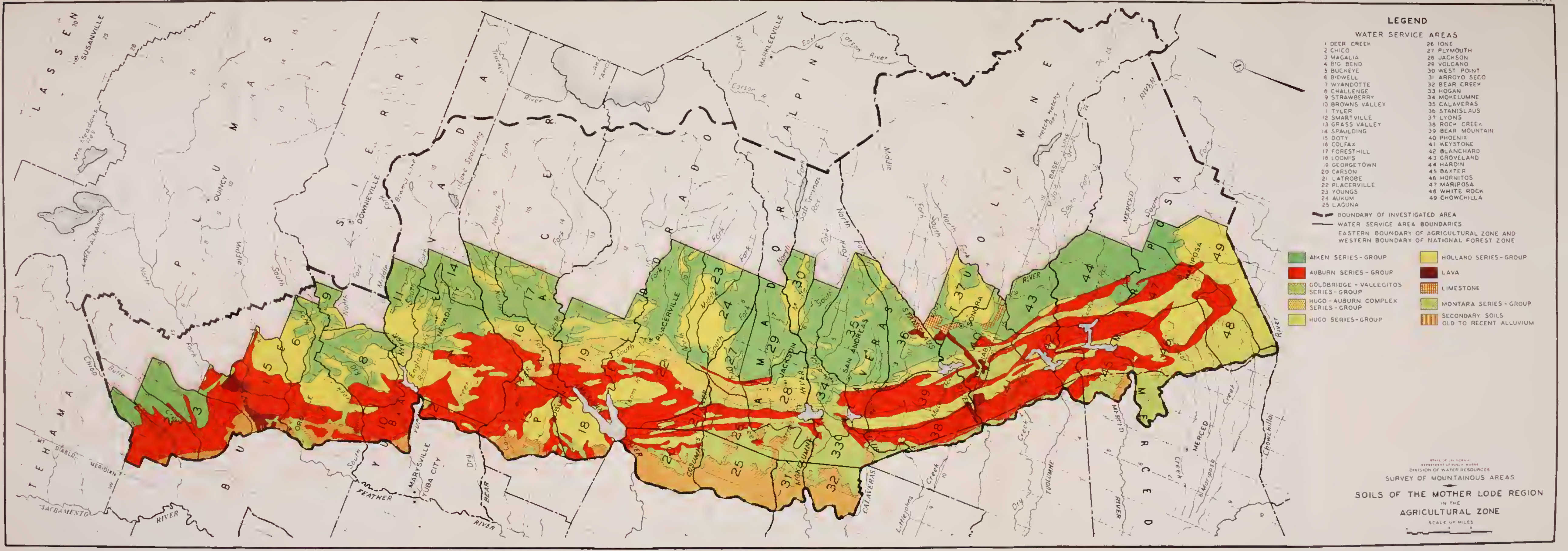
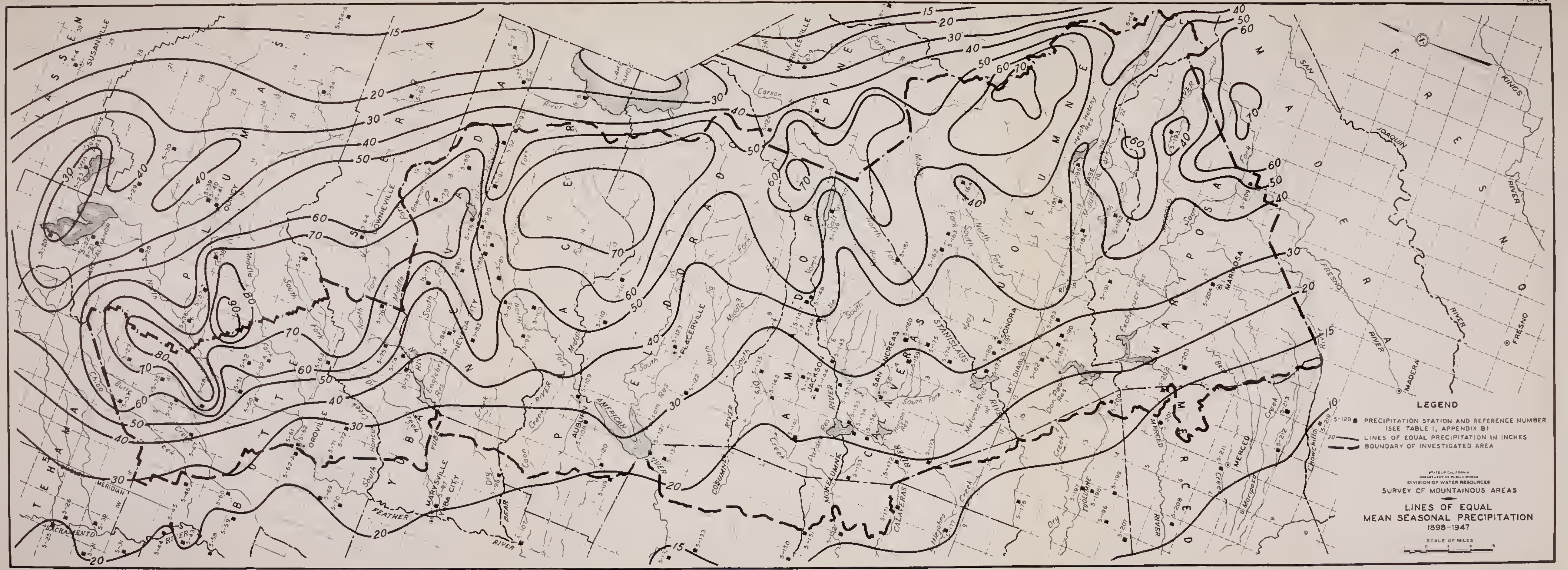
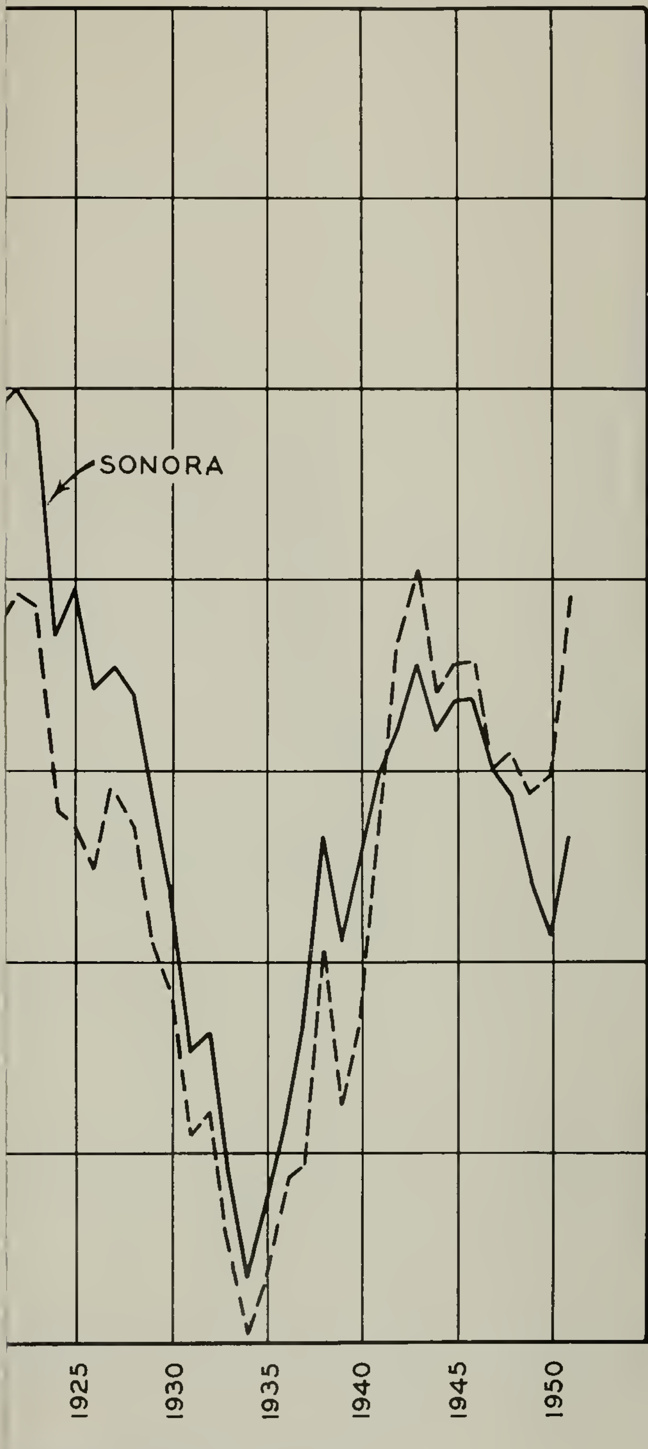
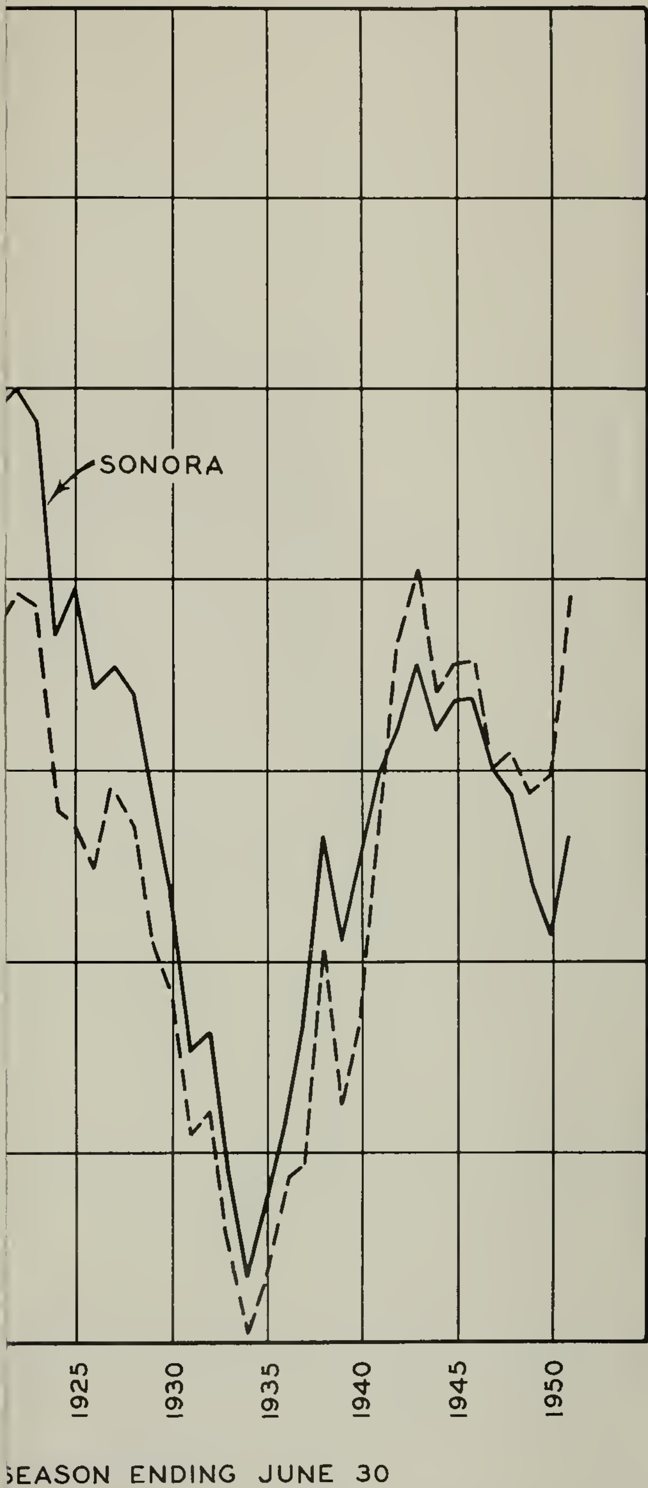

LEGEND
WATER SERVICE AREAS
1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
11 TYLER
12 SMARTVILLE
13 GRASS VALLEY
14 SPAULDING
15 DOTY
16 COLFAX
17 FORESTHILL
18 LOOMIS
19 GEORGETOWN
20 CARSON
21 LATROBE
22 PLACERVILLE
23 YOUNGS
24 AUKUM
25 LAGUNA
26 IONE
27 PLYMOUTH
28 JACKSON
29 VOLCANO
30 WEST POINT
31 ARROYO SECO
32 BEAR CREEK
33 HOGAN
34 MOKELUMNE
35 CALAVERAS
36 STANISLAUS
37 LYONS
38 ROCK CREEK
39 BEAR MOUNTAIN
40 PHOENIX
41 KEYSTONE
42 BLANCHARD
43 GROVELAND
44 HARDIN
45 BAXTER
46 HORNITOS
47 MARIPOSA
48 WHITE ROCK
49 CHOWCHILLA
BOUNDARY OF INVESTIGATED AREA
WATER SERVICE AREA BOUNDARIES
EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE
AIKEN SERIES-GROUP
AUBURN SERIES-GROUP
GOLDBRIDGE-VALLECITOS SERIES-GROUP
HUGO-AUBURN COMPLEX SERIES-GROUP
HUGO SERIES-GROUP
HOLLAND SERIES-GROUP
LAVA
LIMESTONE
MONTARA SERIES-GROUP
SECONDARY SOILS OLD TO RECENT ALLUVIUM
LASSEN
PLUMAS
SIERRA
NEVADA
PLACER
EL DORADO
AMADOR
ALPINE
CALAVERAS
TUOLUMNE
MARIPOSA
MERCED
BUTTE
YUBA
TEHAMA
SUSANVILLE
QUINCY
DOWNIEVILLE
PLACERVILLE
JACKSON
SAN ANDREAS
SONORA
MARKLEEVILLE
MARYSVILLE
YUBA CITY
LAKE TAHOE
LAKE ALMANOR
SACRAMENTO
FEATHER RIVER
BEAR RIVER
MERCED RIVER
TUOLUMNE
MOKELUMNE
COSUMNES
CHOWCHILLA
Carson River
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
SOILS OF THE MOTHER LODE REGION
IN THE
AGRICULTURAL ZONE
SCALE OF MILES

PLATE A

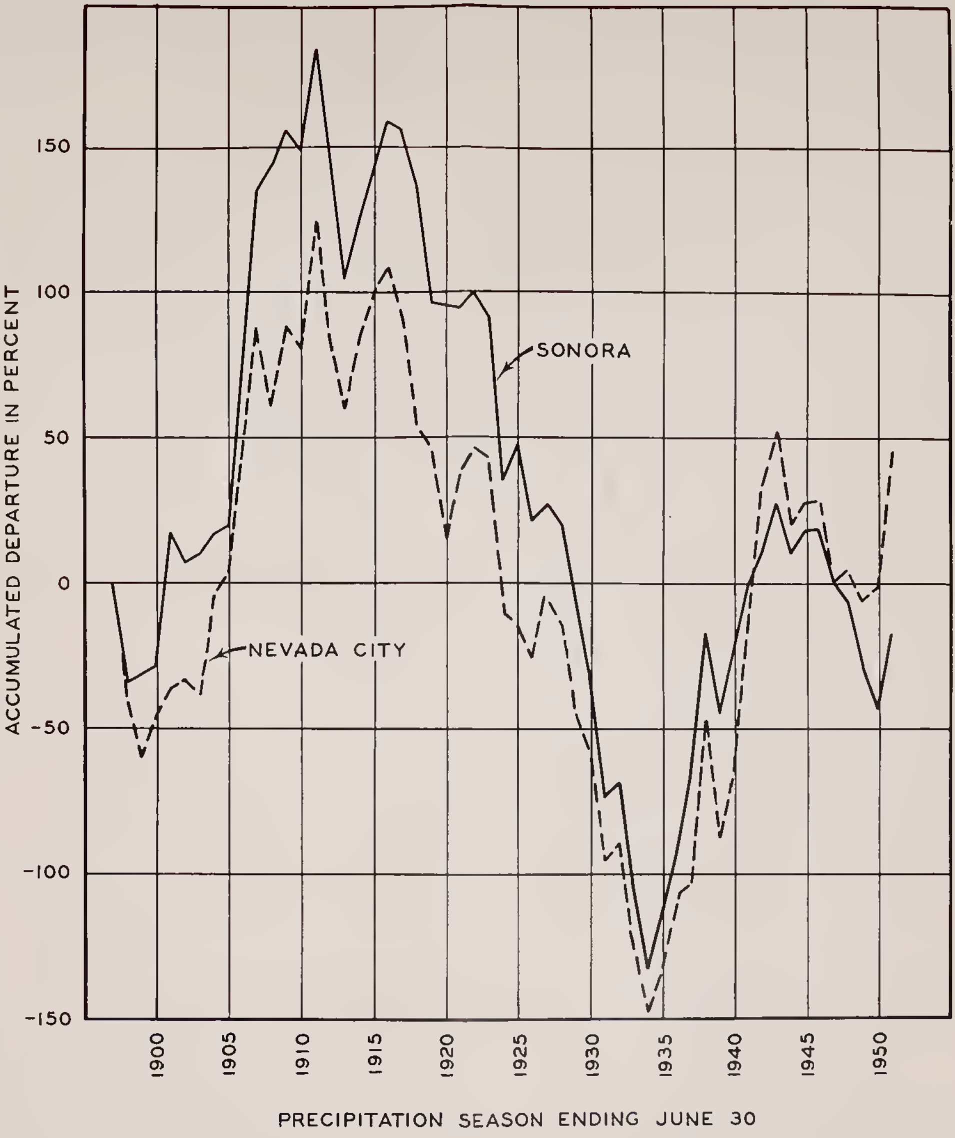

LEGEND
5-120 PRECIPITATION STATION AND REFERENCE NUMBER (SEE TABLE I, APPENDIX B)
20 LINES OF EQUAL PRECIPITATION IN INCHES
BOUNDARY OF INVESTIGATED AREA
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
LINES OF EQUAL
MEAN SEASONAL PRECIPITATION
1898-1947
SCALE OF MILES
SUSANVILLE
QUINCY
DOWNIEVILLE
NEVADA CITY
AUBURN
PLACERVILLE
JACKSON
SAN ANDREAS
SONORA
MARIPOSA
OROVILLE
MARYSVILLE
YUBA CITY
MERCED
MADERA
FRESNO
MARKLEEVILLE
LAKE TAHOE
SACRAMENTO
TEHAMA
BUTTE
YUBA
PLACER
EL DORADO
AMADOR
CALAVERAS
TUOLUMNE
MARIPOSA
MERCED
FRESNO
MADERA
ALPINE
SIERRA
PLUMAS
NEVADA
LASSEN



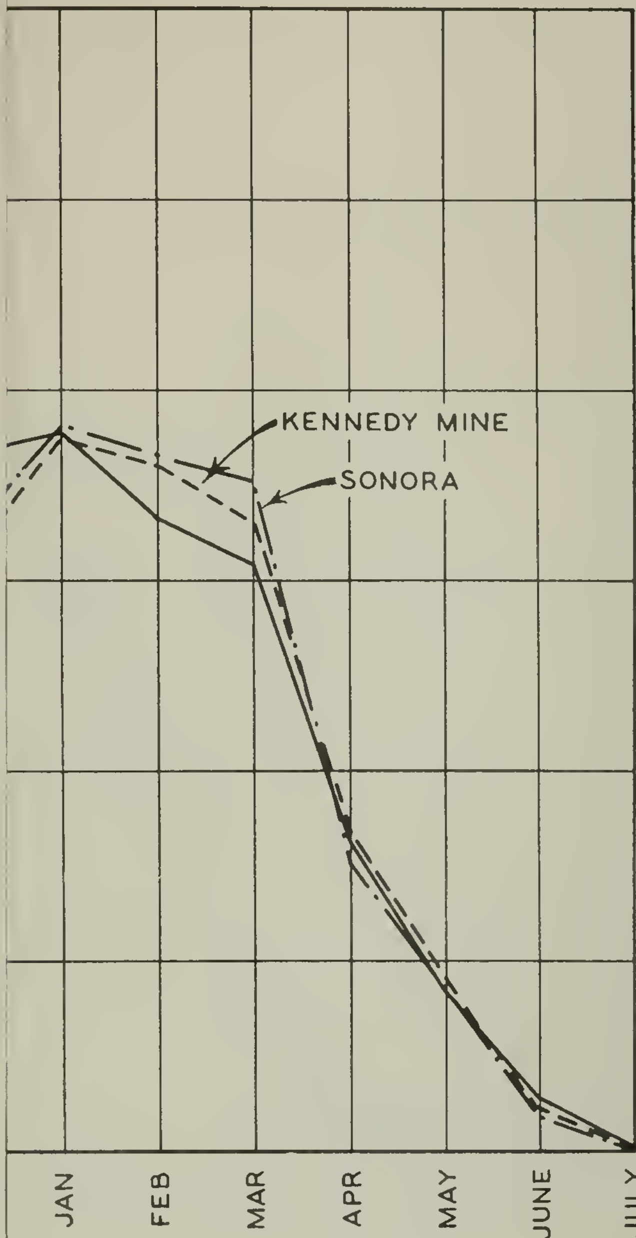
TURE FROM MEAN SEASONAL
ONORA AND NEVADA CITY



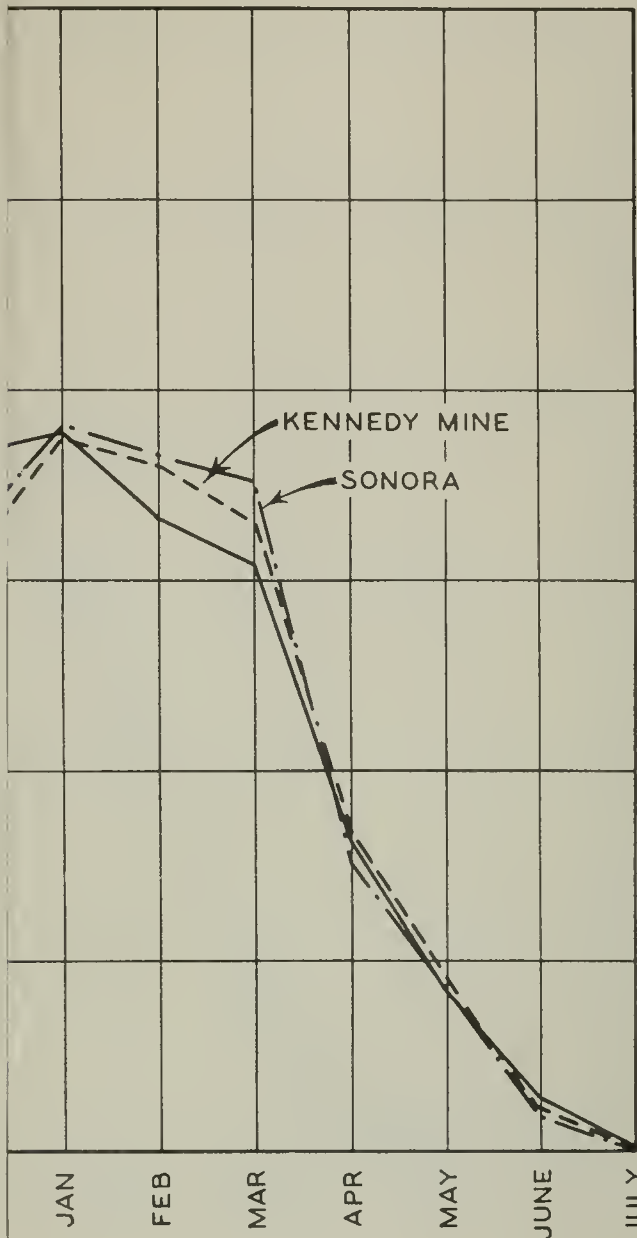
TURE FROM MEAN SEASONAL
ONORA AND NEVADA CITY



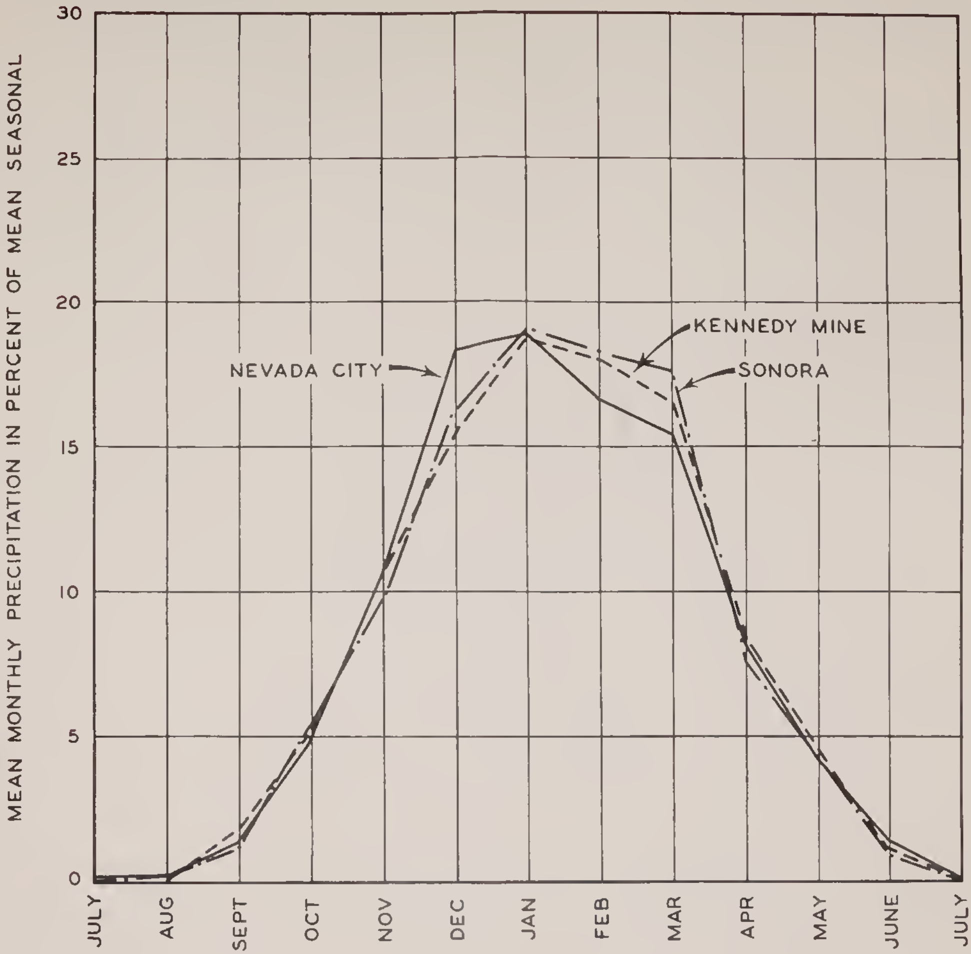
ACCUMULATED DEPARTURE FROM MEAN SEASONAL
PRECIPITATION AT SONORA AND NEVADA CITY



ION OF MEAN SEASONAL
T SELECTED STATIONS

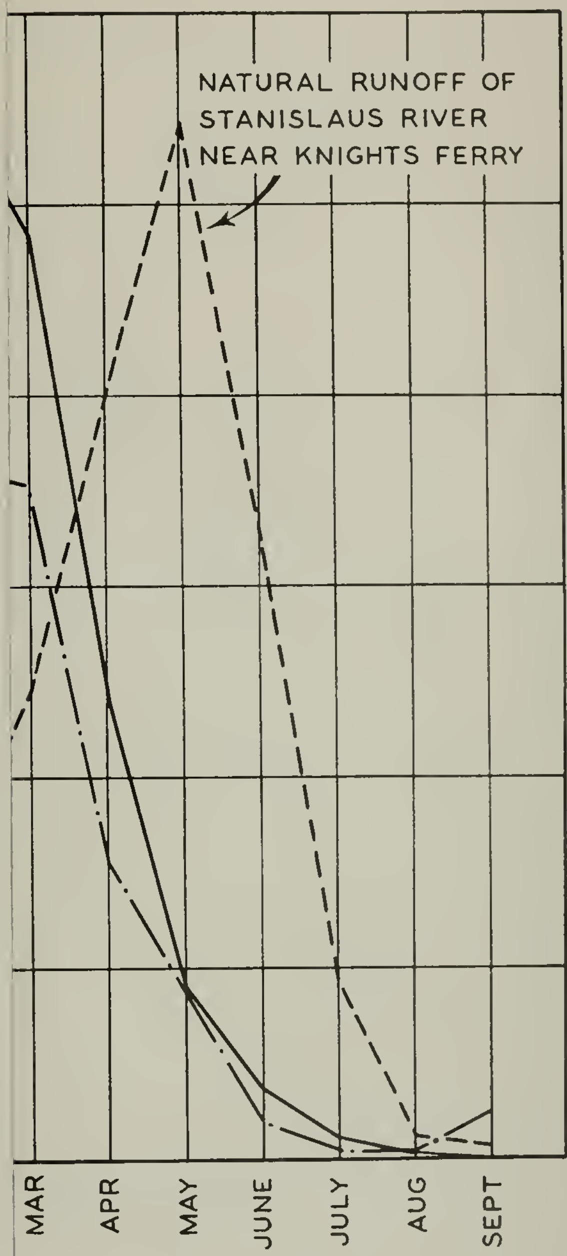


ION OF MEAN SEASONAL
T SELECTED STATIONS

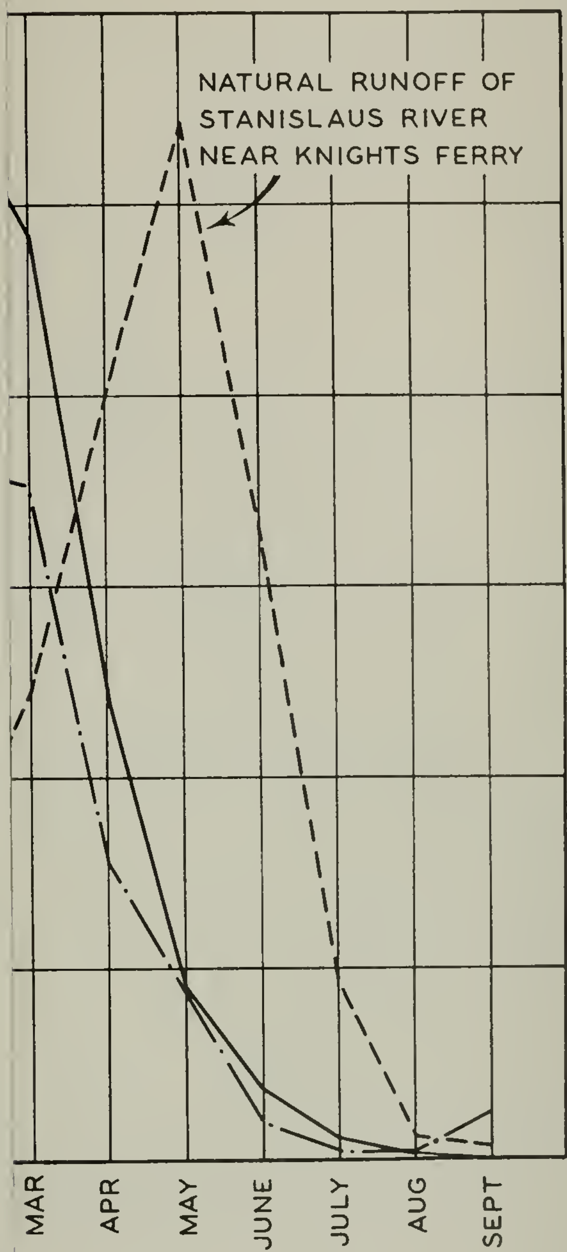


MONTHLY DISTRIBUTION OF MEAN SEASONAL
PRECIPITATION AT SELECTED STATIONS

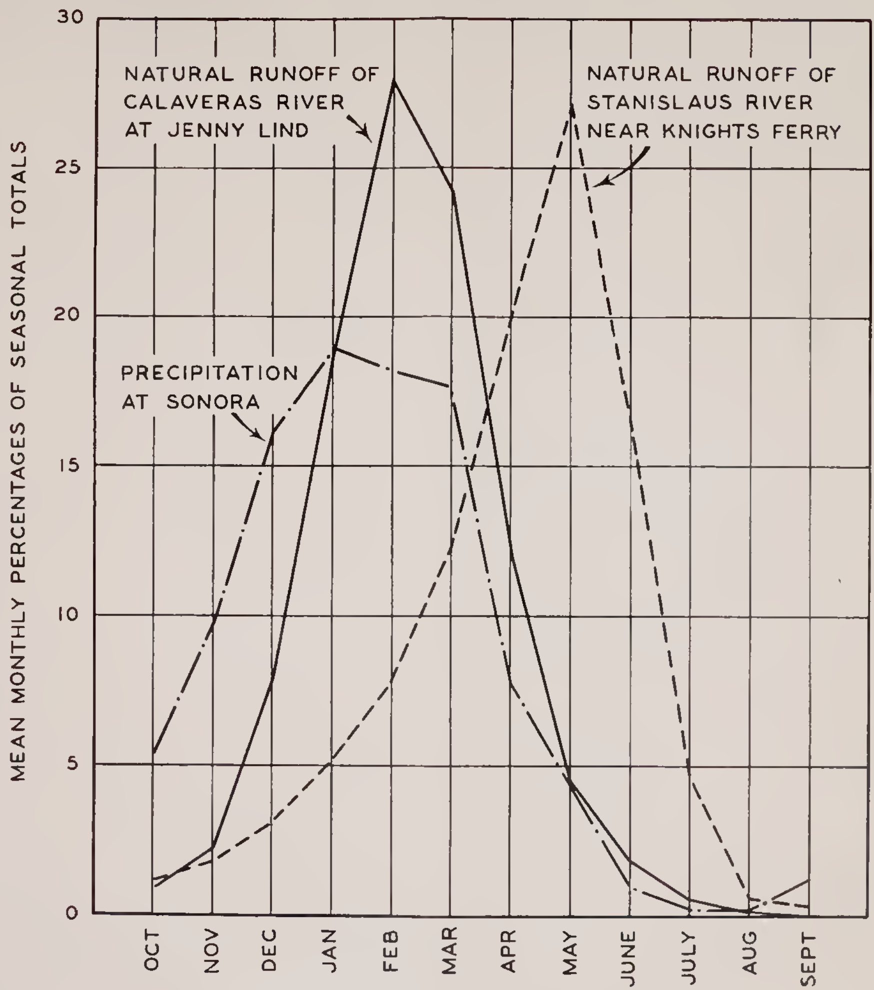
LEGEND
729 GAGING STATION AND REFERENCE STATION —SEE TABLE 2 APPENDIX B—
BOUNDARY OF INVESTIGATED AREA
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
LOCATION OF STREAM GAGING STATIONS
1952
SCALE OF MILES
LASSEN
PLUMAS
SIERRA
NEVADA
PLACER
EL DORADO
ALPINE
AMADOR
CALAVERAS
TUOLUMNE
MARIPOSA
MADERA
FRESNO
MERCED
BUTTE
YUBA
TEHAMA
SUSANVILLE
QUINCY
DOWNIEVILLE
NEVADA CITY
OROVILLE
MARYSVILLE
YUBA CITY
AUBURN
PLACERVILLE
JACKSON
SAN ANDREAS
SONORA
MARIPOSA
MERCED
MADERA
FRESNO
MARKLEEVILLE
MT. DIABLO MERIDIAN
SACRAMENTO RIVER
FEATHER RIVER
YUBA RIVER
BEAR RIVER
AMERICAN RIVER
COSUMNES RIVER
MOKELUMNE RIVER
CALAVERAS RIVER
STANISLAUS RIVER
TUOLUMNE RIVER
MERCED RIVER
SAN JOAQUIN RIVER
FRESNO RIVER
KINGS RIVER
Chowchilla
Folsom Res
Lake Tahoe
Carson River
Don Pedro Res



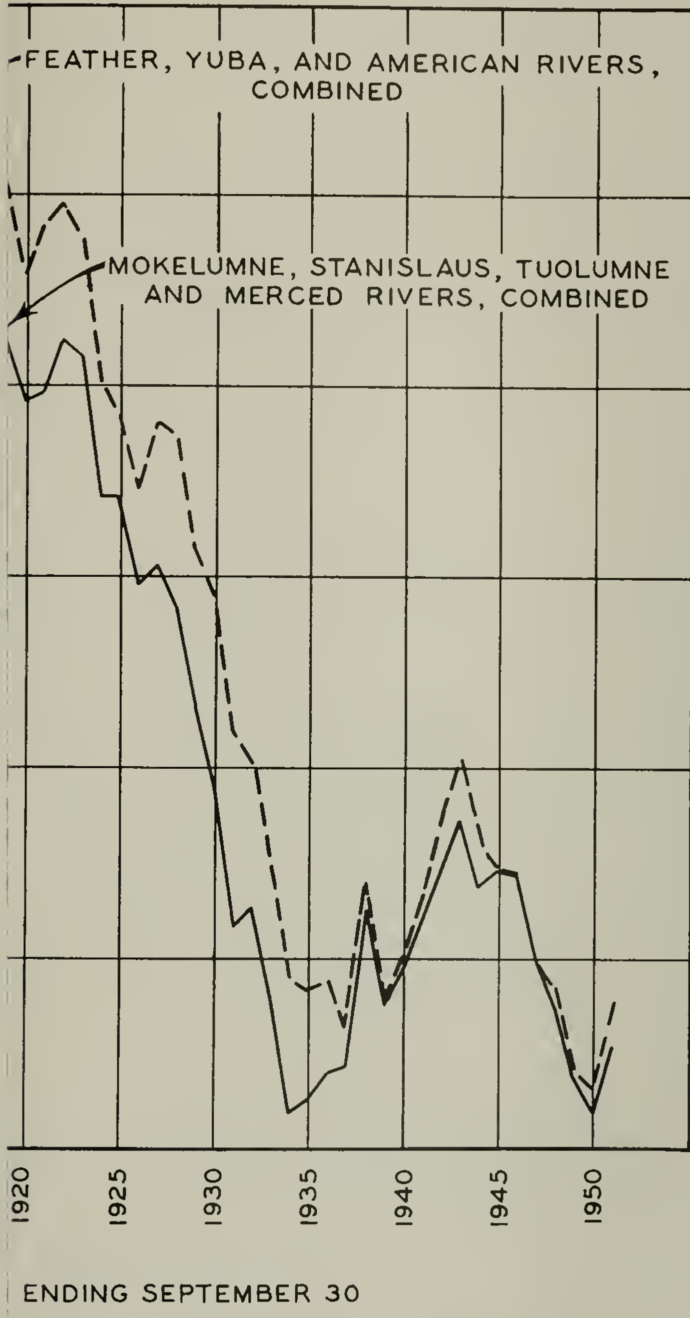
OF SNOWSHED STORAGE
OF MONTHLY RUNOFF



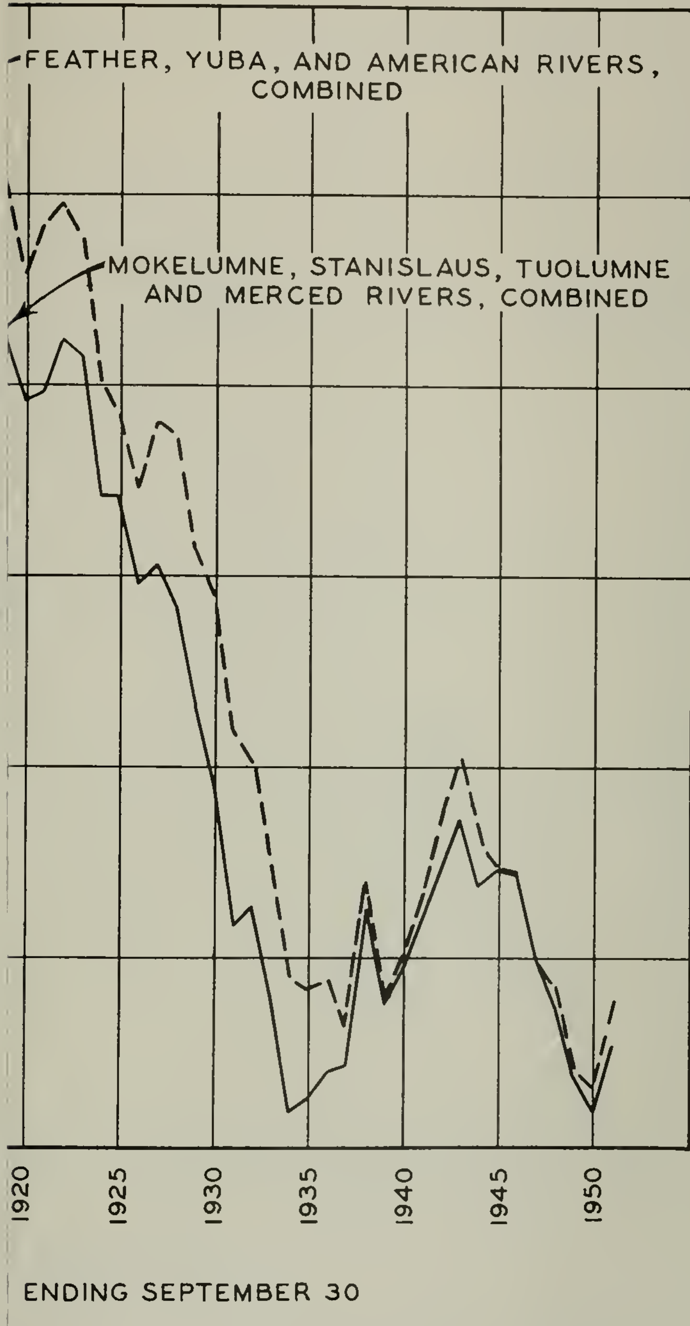
OF SNOWSHED STORAGE
E OF MONTHLY RUNOFF



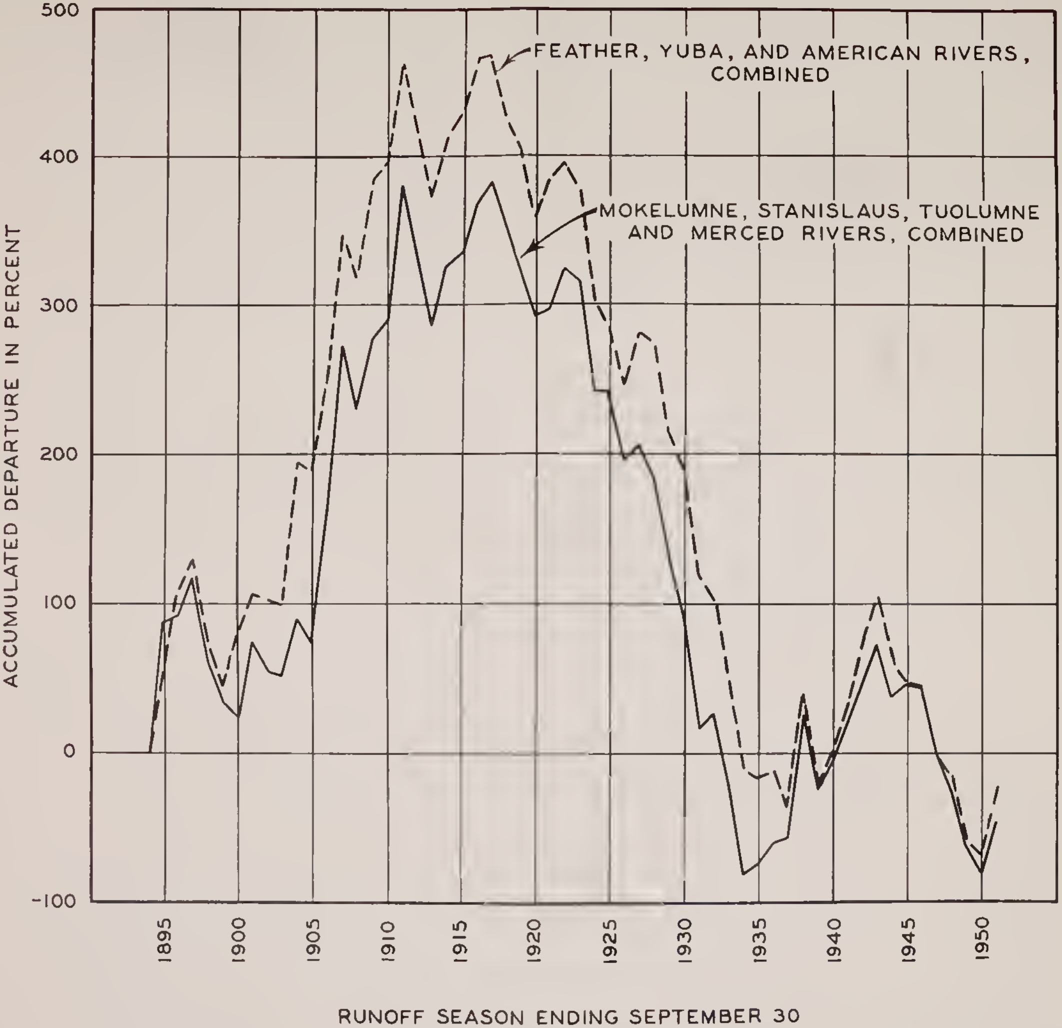
TYPICAL EFFECT OF SNOWSHED STORAGE
ON OCCURRENCE OF MONTHLY RUNOFF



RE FROM MEAN SEASONAL
MAJOR STREAM GROUPS



RE FROM MEAN SEASONAL
MAJOR STREAM GROUPS



ACCUMULATED DEPARTURE FROM MEAN SEASONAL
NATURAL RUNOFF OF MAJOR STREAM GROUPS

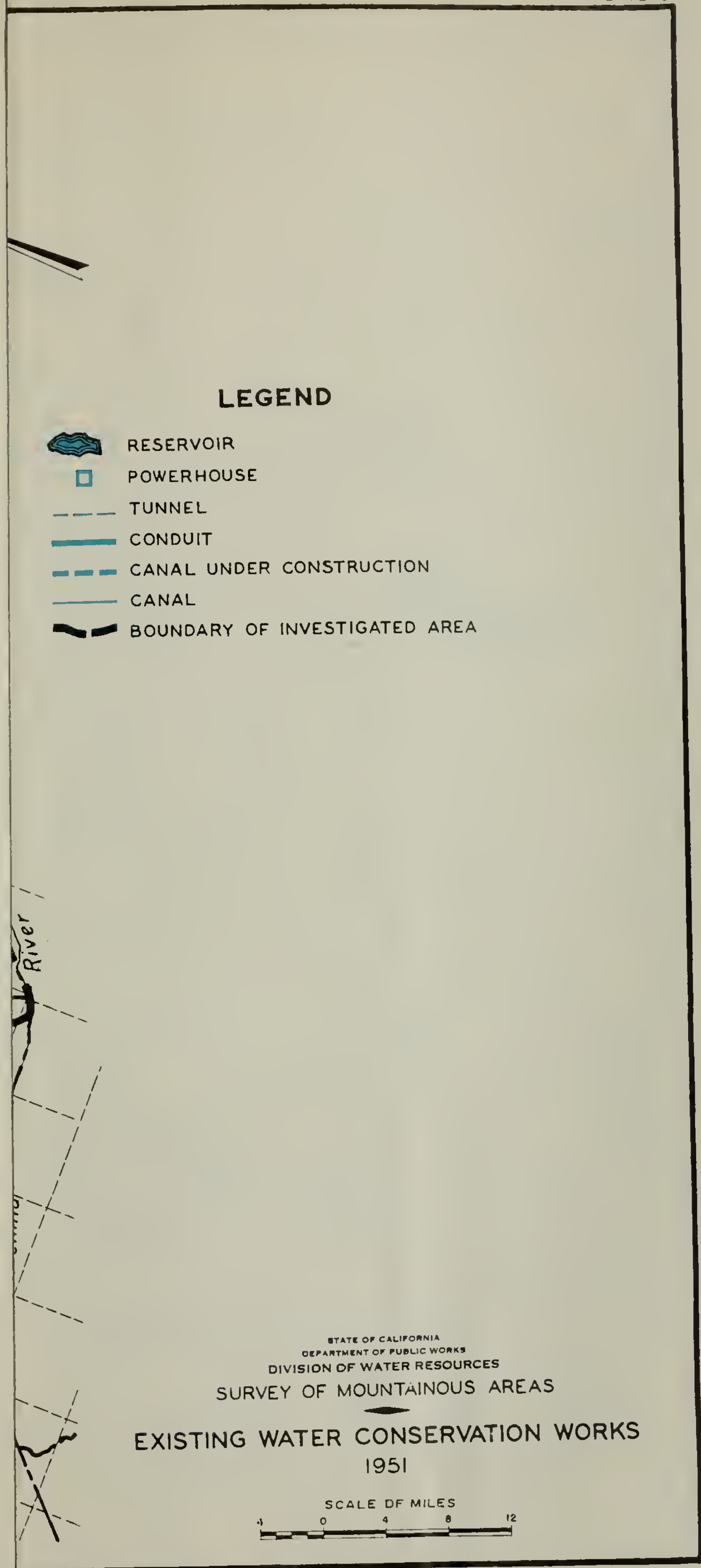
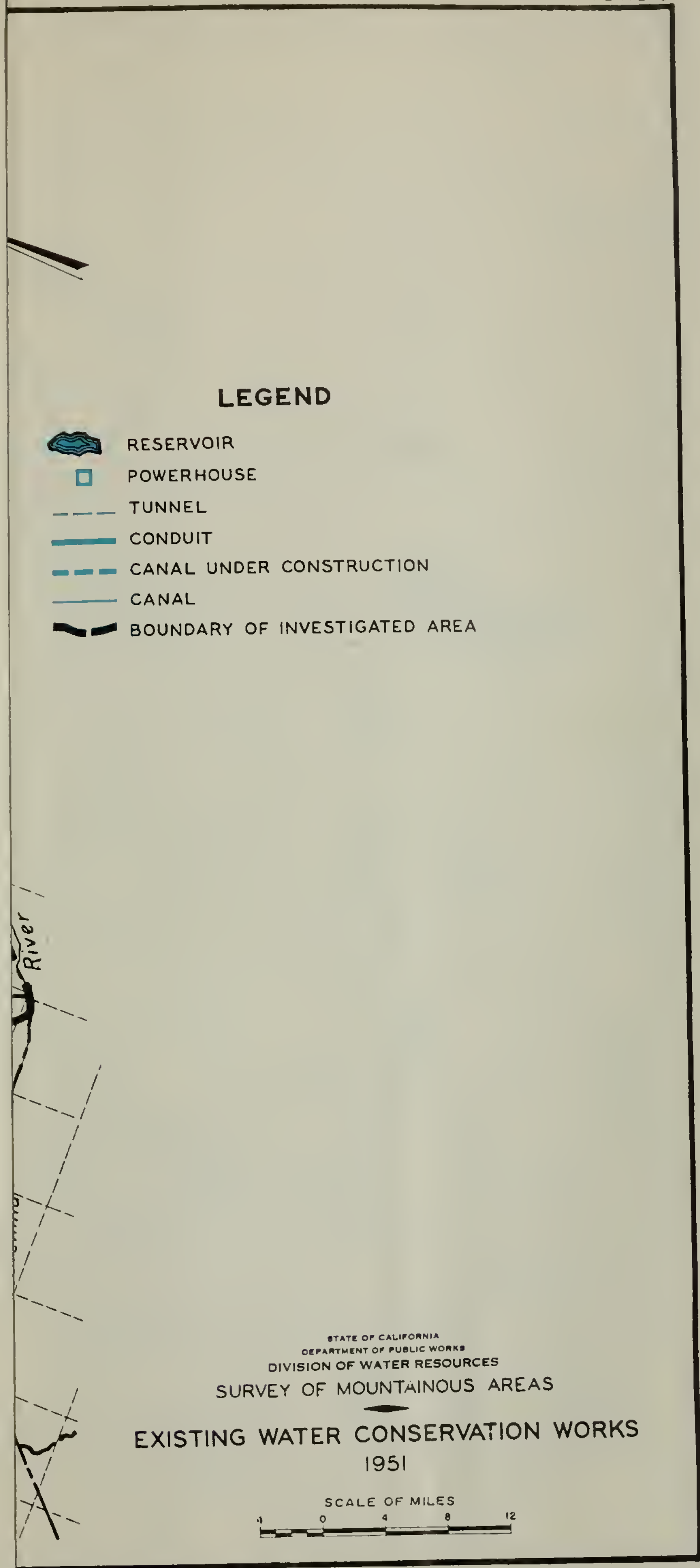

LEGEND
RESERVOIR
POWERHOUSE
TUNNEL
CONDUIT
CANAL UNDER CONSTRUCTION
CANAL
BOUNDARY OF INVESTIGATED AREA
River
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
EXISTING WATER CONSERVATION WORKS
1951
SCALE OF MILES
4 0 4 8 12

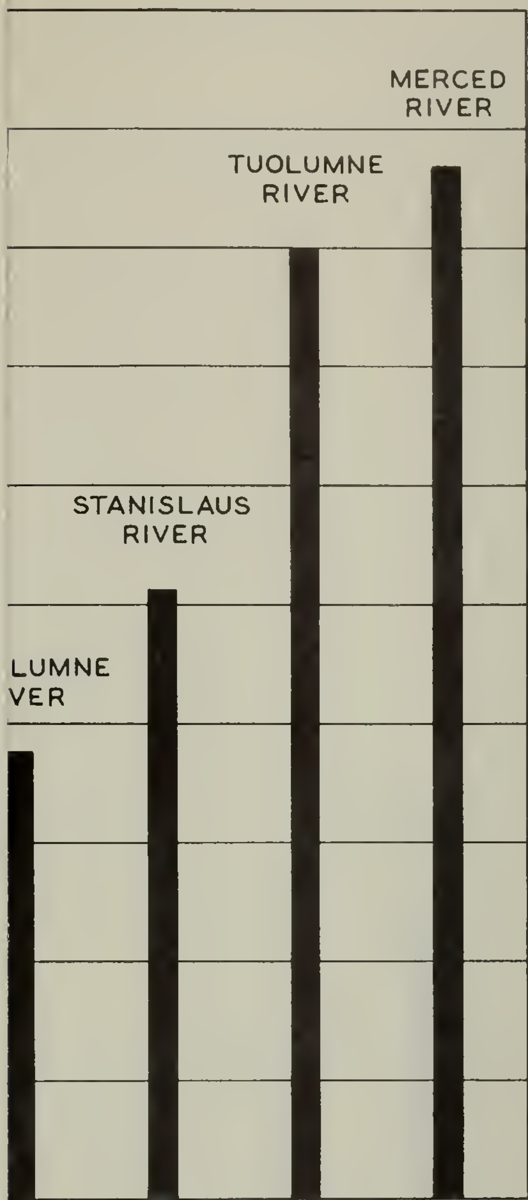
PLATE 10



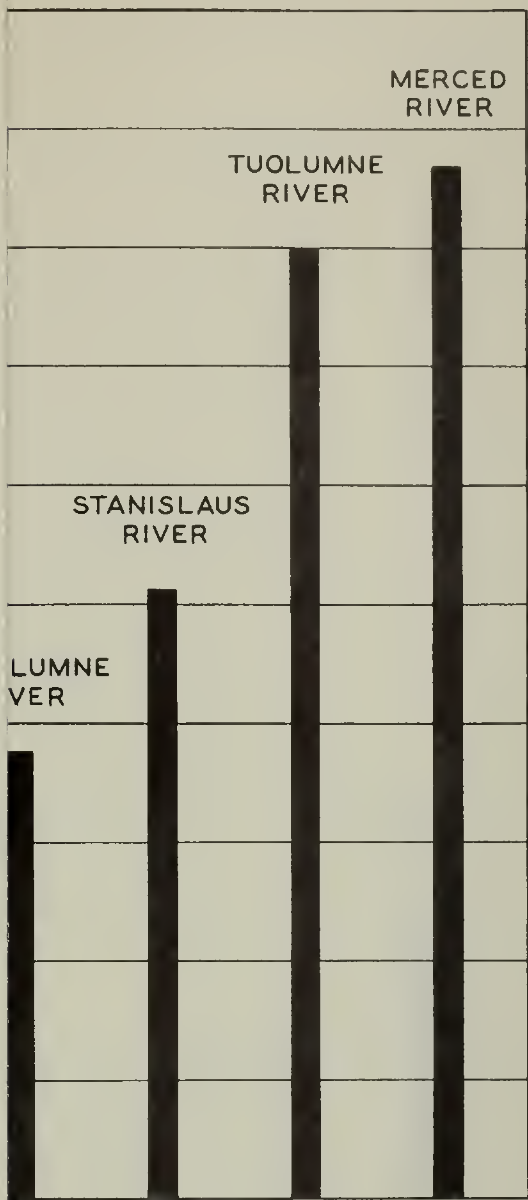
LEGEND
RESERVOIR
POWERHOUSE
TUNNEL
CONDUIT
CANAL UNDER CONSTRUCTION
CANAL
BOUNDARY OF INVESTIGATED AREA
River
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
EXISTING WATER CONSERVATION WORKS
1951
SCALE OF MILES
4 0 4 8 12

PLATE 10

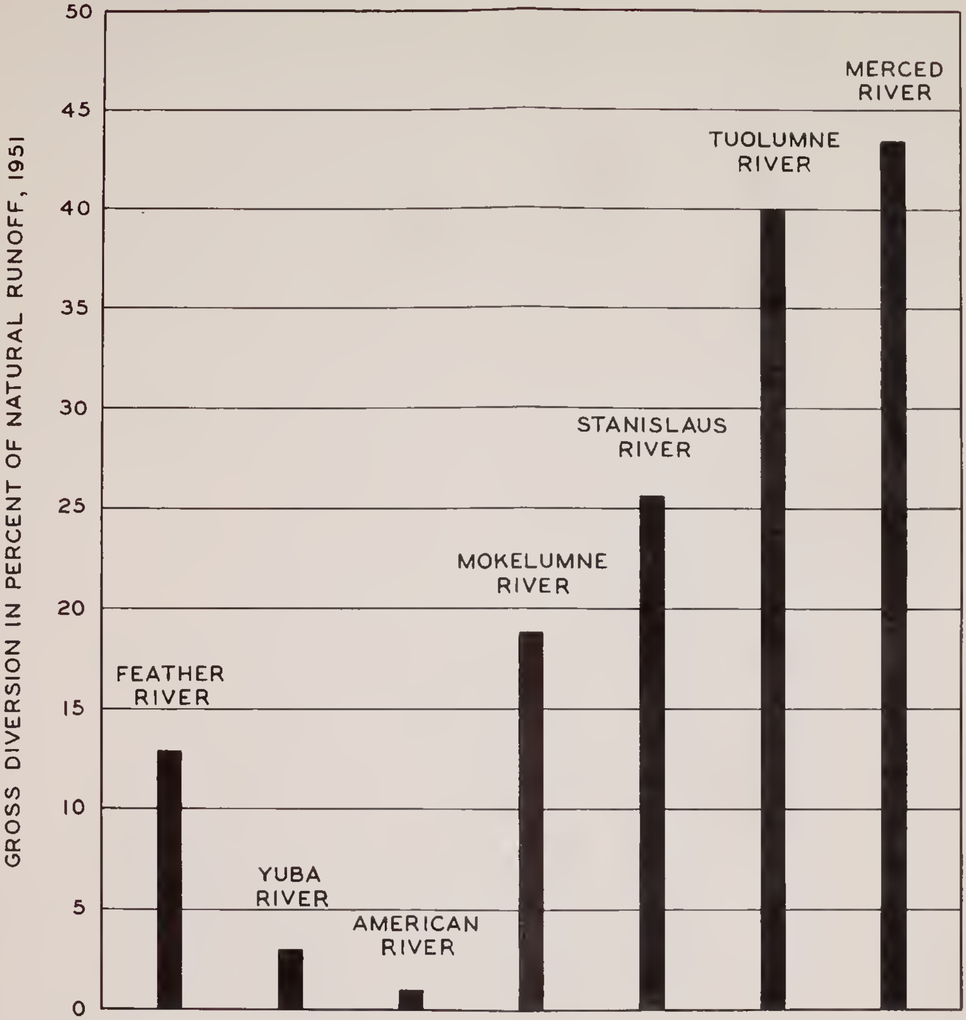

LEGEND
RESERVOIR
POWERHOUSE
TUNNEL
CONDUIT
CANAL UNDER CONSTRUCTION
CANAL
BOUNDARY OF INVESTIGATED AREA
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
EXISTING WATER CONSERVATION WORKS
1951
SCALE OF MILES
LASSEN
SUSANVILLE
PLUMAS
QUINCY
SIERRA
DOWNIEVILLE
NEVADA
NEVADA CITY
PLACER
AUBURN
EL DORADO
PLACERVILLE
ALPINE
MARKLEEVILLE
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
TUOLUMNE
SONORA
MARIPOSA
MERCED
BUTTE
OROVILLE
YUBA
MARYSVILLE
YUBA CITY
TEHAMA
HAMILTON BRANCH P H
CARIBOU P H
ROCK CREEK P H
BUCKS CREEK P H
CRESTA P H
BIG BEND P H
DE SABLA P H
CENTERVILLE P H
LIME SADDLE P H
MIOCENE CANAL
COAL CANYON P H
PALERMO CANAL
OROVILLE-WYANDOTTE CANAL
BULLARDS BAR P H
SOUTH YUBA CANAL
DEER CREEK P H
EXCELSIOR DITCH
COLGATE P H
BROWNS VALLEY DITCH
HALLWOOD - CORDUA CANAL
NARROWS P H
MILTON BOWMAN TUNNEL
BOWMAN SPAULDING CONDUIT
SPAULDING P H NO 2
SPAULDING P H NO 3
SPAULDING P H NO 1
DRUM CANAL
DRUM P H
ALTA P H
DUTCH FLAT P H
BOARDMAN CANAL
BEAR RIVER CANAL
HALSEY P H
WISE P H
GEORGETOWN DIVIDE DITCH
AMERICAN RIVER P H
FOLSOM P H
NORTH FORK DITCH
NIMBUS P H
NATOMAS DITCH
EL DORADO P H
EL DORADO MAIN CANAL
DIAMOND RIDGE DITCH
PLYMOUTH DITCH
TIGER CREEK P H
WEST POINT P H
AMADOR CANAL
SALT SPRINGS P H
TIGER CREEK CONDUIT
ELECTRA P H
PARDEE P H
MOKELUMNE AQUEDUCT
CALAVERAS PUD DITCH
UTICA CANAL
MURPHYS P H
STANISLAUS P H
SPRING GAP P H
STANISLAUS TUNNEL
ANGELS P H
SOUTH SAN JOAQUIN I D MAIN CANAL
MELONES P H
PHOENIX P H
TUOLUMNE CANAL
MT DIABLO
MOCCASIN P H
EARLY INTAKE P H
HETCH HETCHY AQUEDUCT
DON PEDRO P H
OAKDALE I D MAIN CANAL
MODESTO CANAL
TURLOCK CANAL
LA GRANGE P H
YOSEMITE P H
EXCHEQUER P H
MERCED FALLS P H
NORTH SIDE CANAL
MERCED I D MAIN CANAL
MT DIABLO MERIDIAN
Folsom Res
Exchequer Res
Hetch Hetchy Res
Lake Eleanor
Relief Res
Strawberry Res
Salt Springs Res
Pardee Res
Don Pedro Res
Melones Res
Almanor
FEATHER
SACRAMENTO
AMERICAN
COSUMNES
MOKELUMNE
CALAVERAS
STANISLAUS
TUOLUMNE
BEAR
Chowchilla



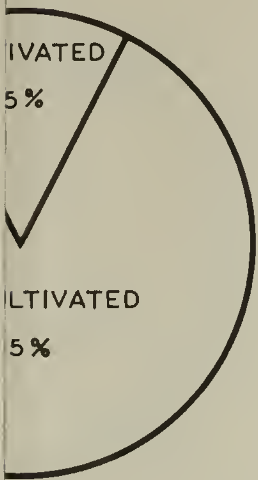
ONS FROM THE MOTHER LODE
ENCIES OUTSIDE THE REGION



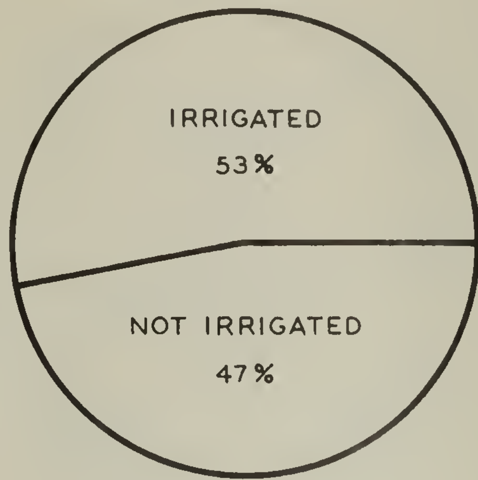
ONS FROM THE MOTHER LODE
ENCIES OUTSIDE THE REGION



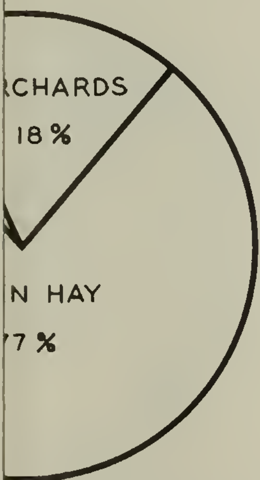
COMPARISON OF 1951 DIVERSIONS FROM THE MOTHER LODE BY MAJOR WATER SERVICE AGENCIES OUTSIDE THE REGION



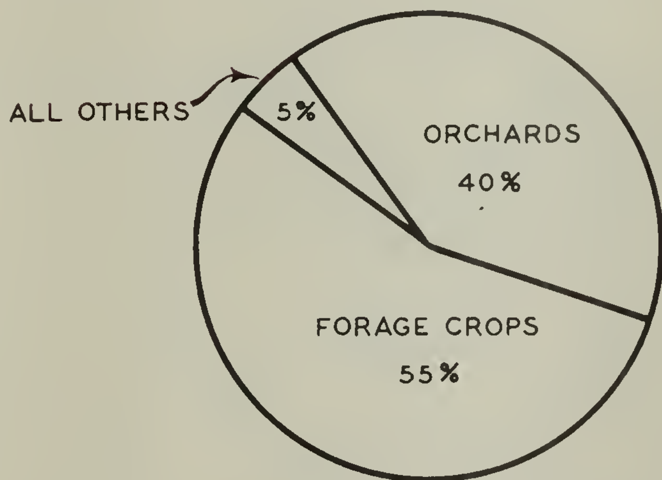
GABLE AREA



TOTAL CULTIVATED AREA

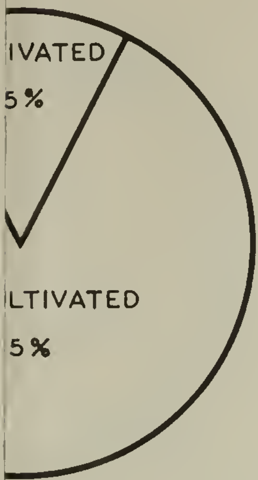


ARMED CROPS

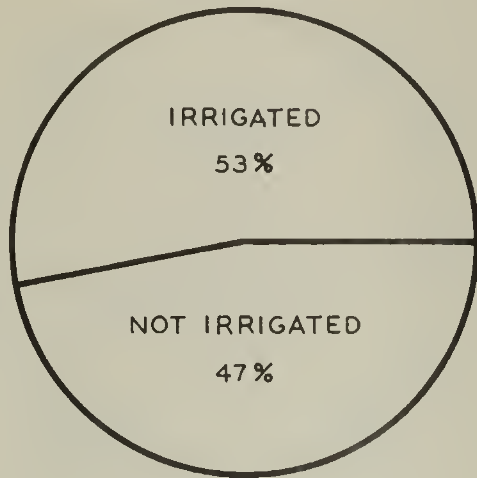


ALL CULTIVATED CROPS

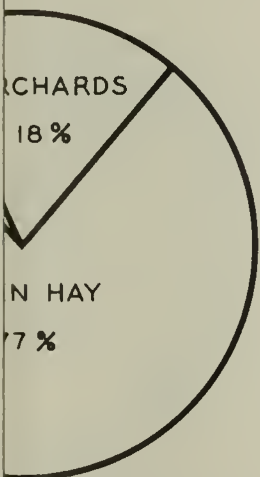
S IN THE AGRICULTURAL ZONE
950



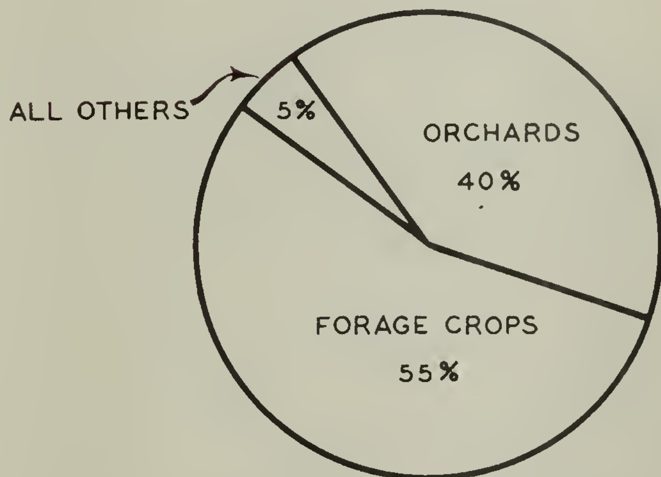
GABLE AREA



TOTAL CULTIVATED AREA

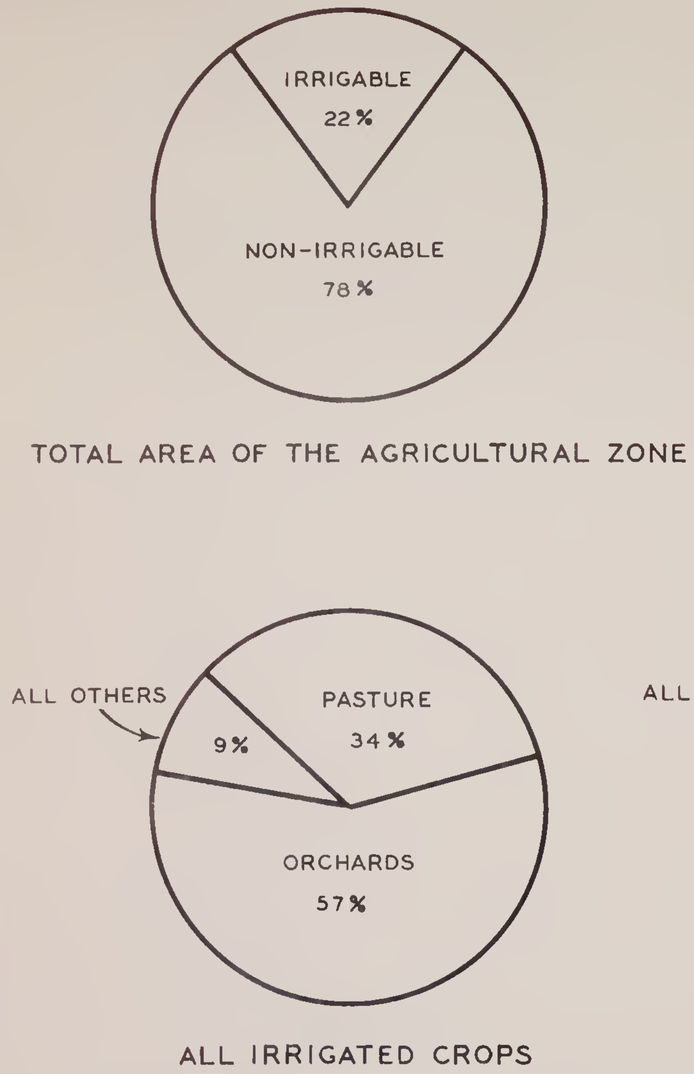


ARMED CROPS



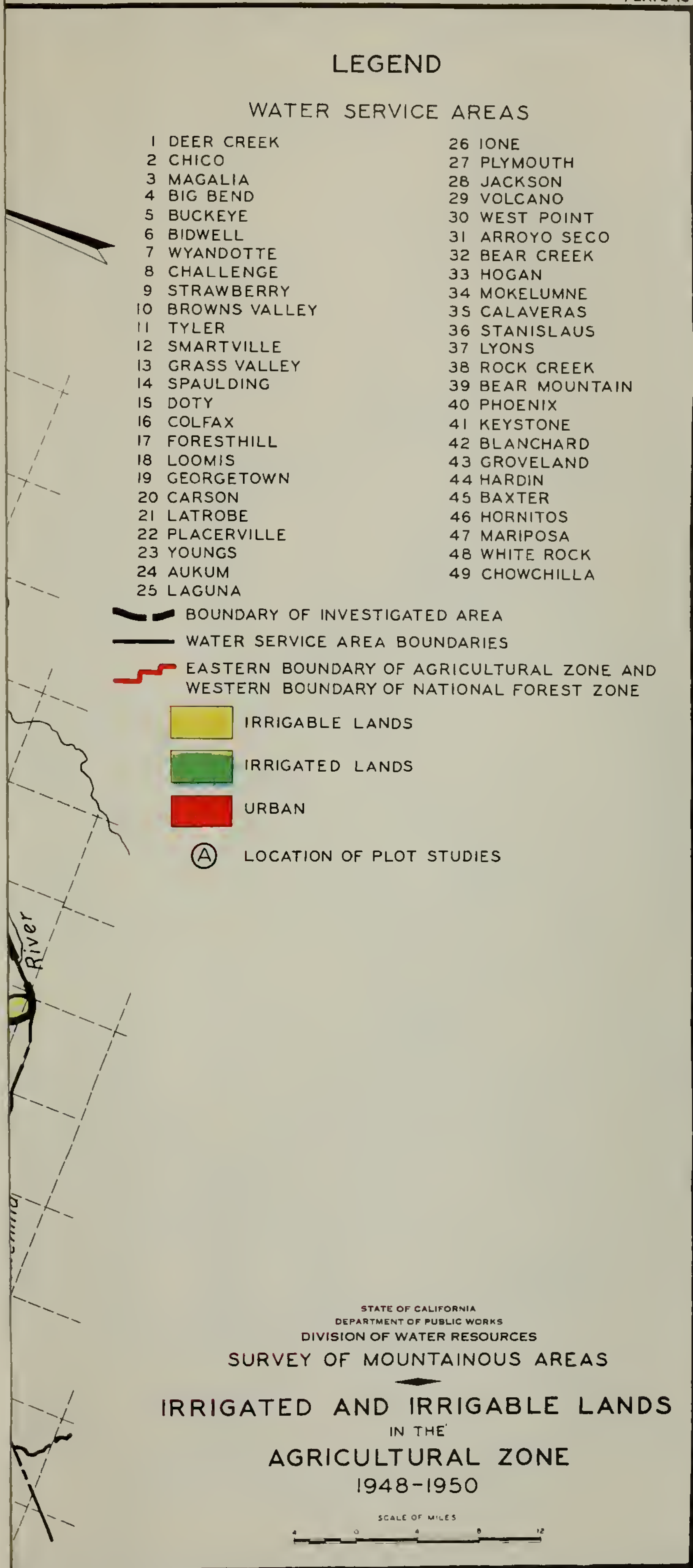
ALL CULTIVATED CROPS

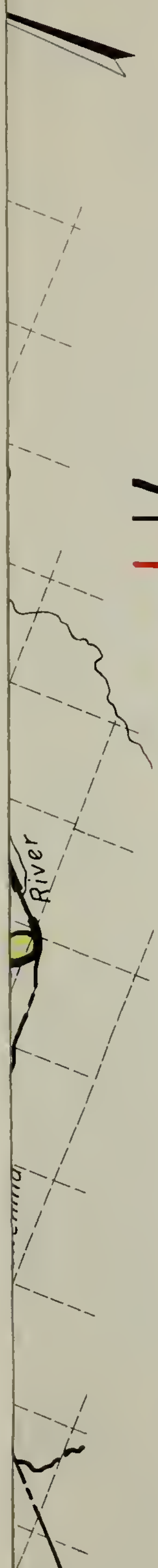
S IN THE AGRICULTURAL ZONE
950



PRESENT USE OF IRRIGABLE LANDS IN THE AGRICULTURAL ZONE

1948-1950


LEGEND
WATER SERVICE AREAS
1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
11 TYLER
12 SMARTVILLE
13 GRASS VALLEY
14 SPAULDING
15 DOTY
16 COLFAX
17 FORESTHILL
18 LOOMIS
19 GEORGETOWN
20 CARSON
21 LATROBE
22 PLACERVILLE
23 YOUNGS
24 AUKUM
25 LAGUNA
26 IONE
27 PLYMOUTH
28 JACKSON
29 VOLCANO
30 WEST POINT
31 ARROYO SECO
32 BEAR CREEK
33 HOGAN
34 MOKELUMNE
35 CALAVERAS
36 STANISLAUS
37 LYONS
38 ROCK CREEK
39 BEAR MOUNTAIN
40 PHOENIX
41 KEYSTONE
42 BLANCHARD
43 GROVELAND
44 HARDIN
45 BAXTER
46 HORNITOS
47 MARIPOSA
48 WHITE ROCK
49 CHOWCHILLA
BOUNDARY OF INVESTIGATED AREA
WATER SERVICE AREA BOUNDARIES
EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE
IRRIGABLE LANDS
IRRIGATED LANDS
URBAN
A LOCATION OF PLOT STUDIES
River
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
IRRIGATED AND IRRIGABLE LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SCALE OF MILES
4 0 4 8 12



LEGEND

WATER SERVICE AREAS

1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
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BOUNDARY OF INVESTIGATED AREA

WATER SERVICE AREA BOUNDARIES

EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE

IRRIGABLE LANDS

IRRIGATED LANDS

URBAN

Ⓐ LOCATION OF PLOT STUDIES

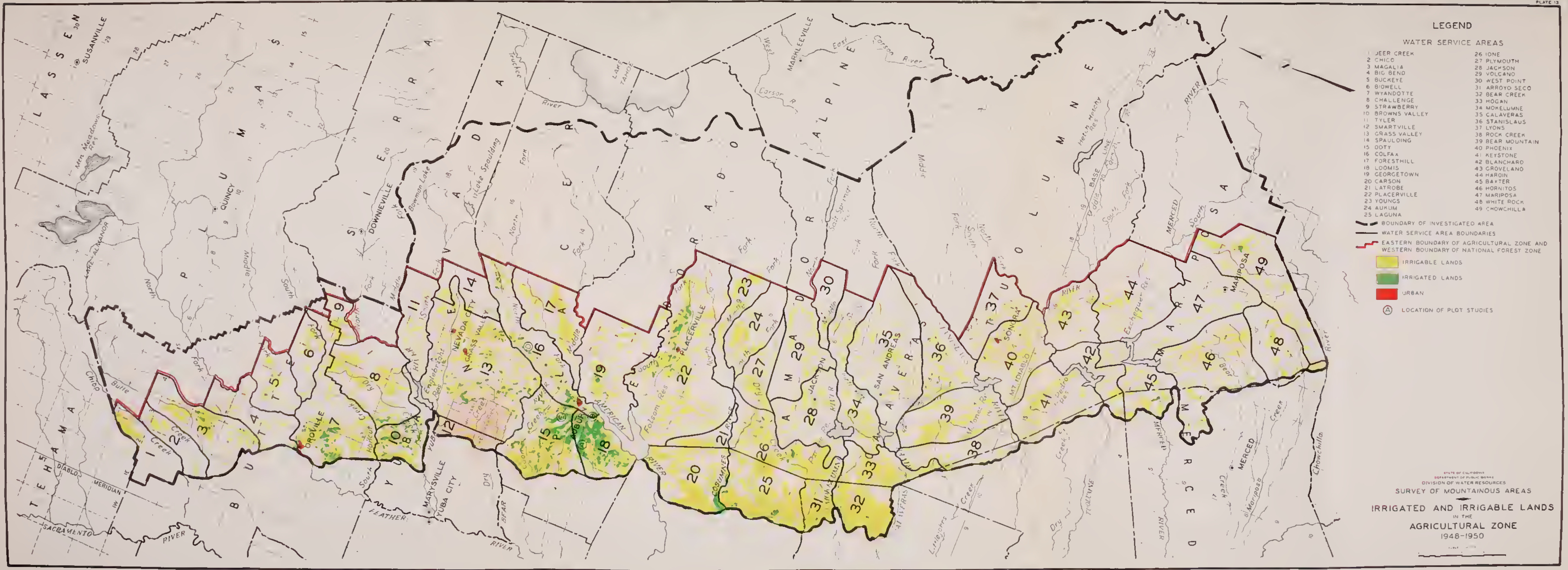
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SURVEY OF MOUNTAINOUS AREAS

IRRIGATED AND IRRIGABLE LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SCALE OF MILES

PLATE 13



LEGEND
WATER SERVICE AREAS
1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
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BOUNDARY OF INVESTIGATED AREA
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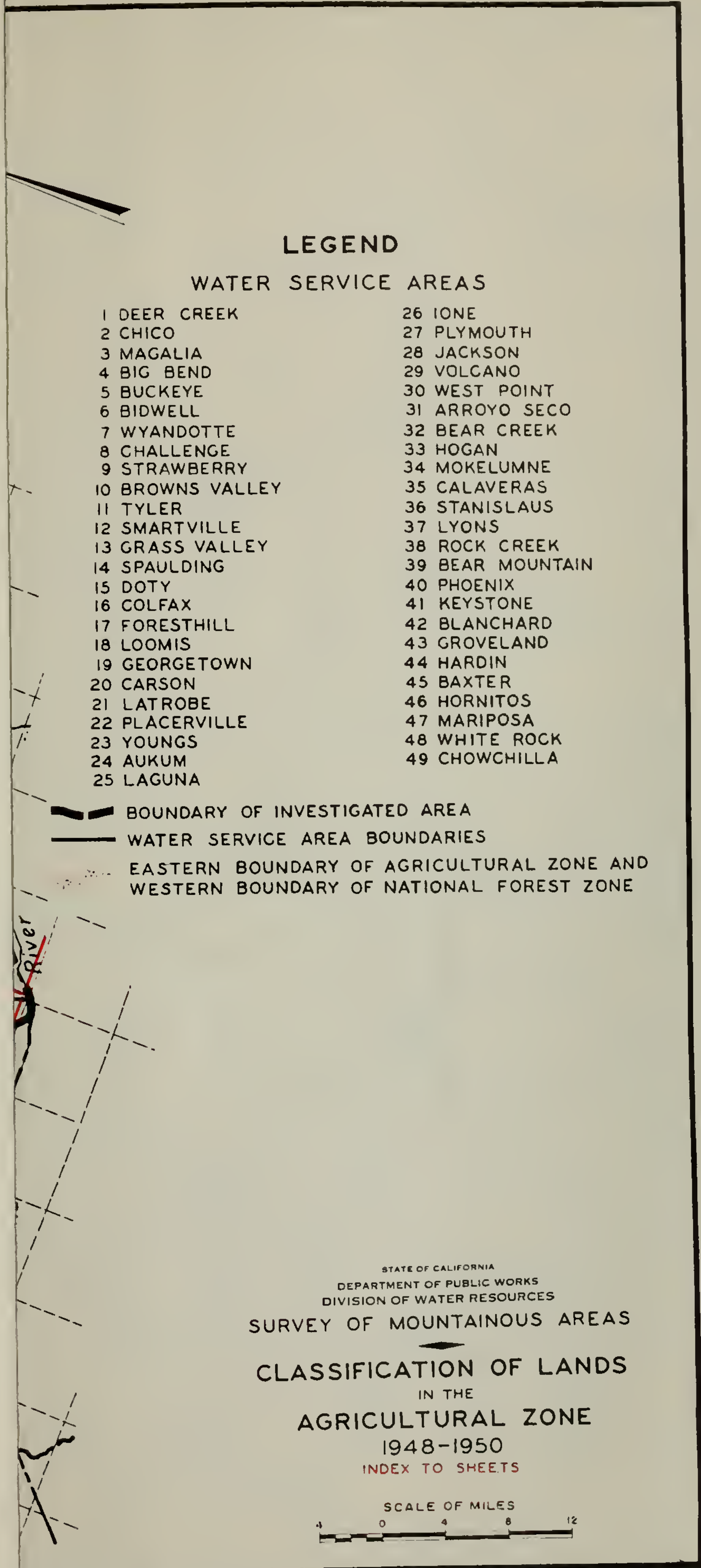
EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE
IRRIGABLE LANDS
IRRIGATED LANDS
URBAN
LOCATION OF PLOT STUDIES
DIVISION OF WATER RESOURCES
SURVEY OF MOUNTAINOUS AREAS
IRRIGATED AND IRRIGABLE LANDS
IN THE
AGRICULTURAL ZONE
1948–1950



River
LEGEND
WATER SERVICE AREAS
1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
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WESTERN BOUNDARY OF NATIONAL FOREST ZONE
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IN THE
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1948-1950
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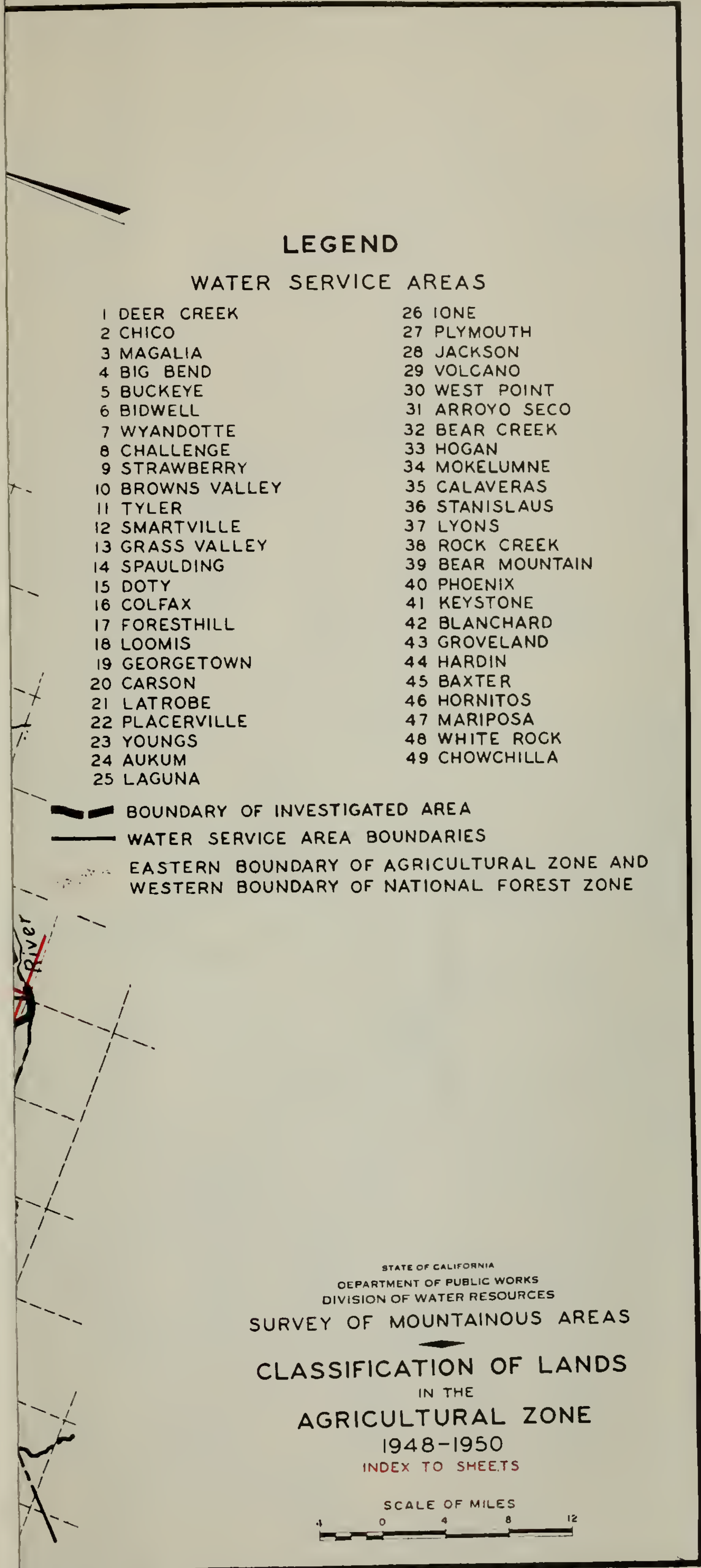
4 0 4 8 12


LEGEND
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4 BIG BEND
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6 BIDWELL
7 WYANDOTTE
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BOUNDARY OF INVESTIGATED AREA
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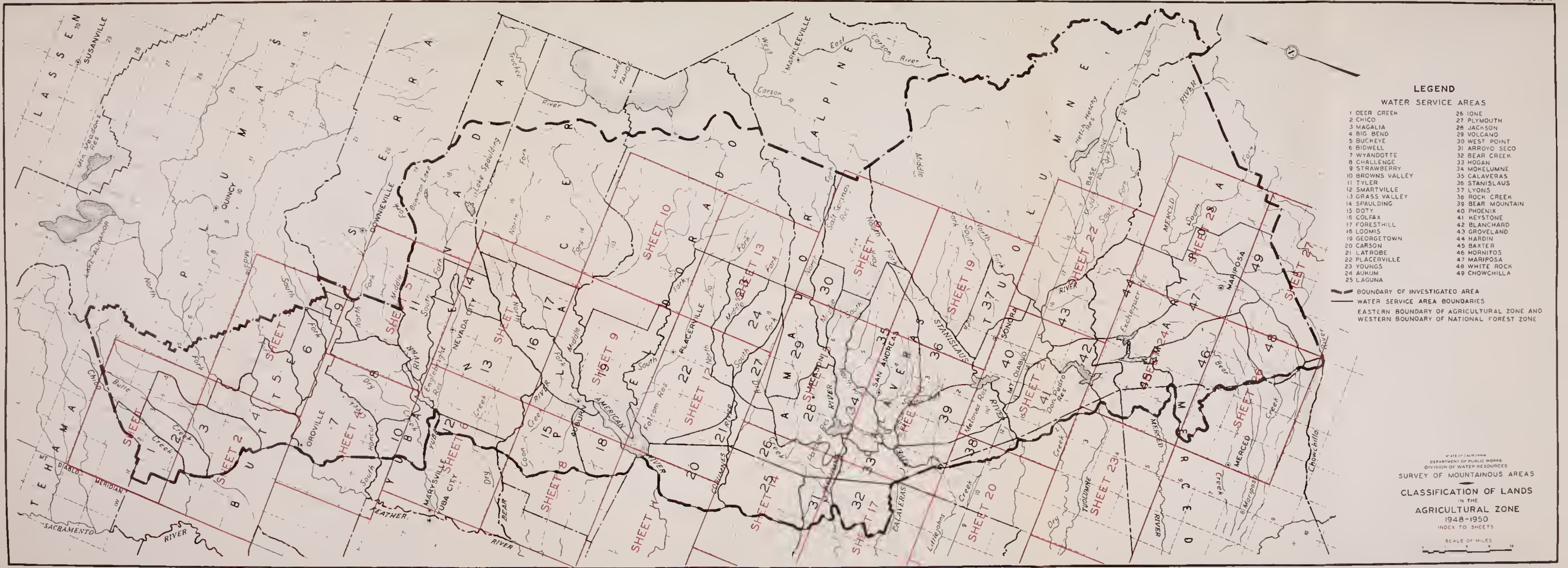
4 0 4 8 12


LEGEND
WATER SERVICE AREAS
1 DEER CREEK
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4 BIG BEND
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NEVADA
PLACER
EL DORADO
AMADOR
ALPINE
CALAVERAS
TUOLUMNE
MARIPOSA
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SACRAMENTO
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RIVER
AMERICAN
COSUMNES
MOKELUMNE
STANISLAUS
SHEET 1
SHEET 2
SHEET 3
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SHEET 5
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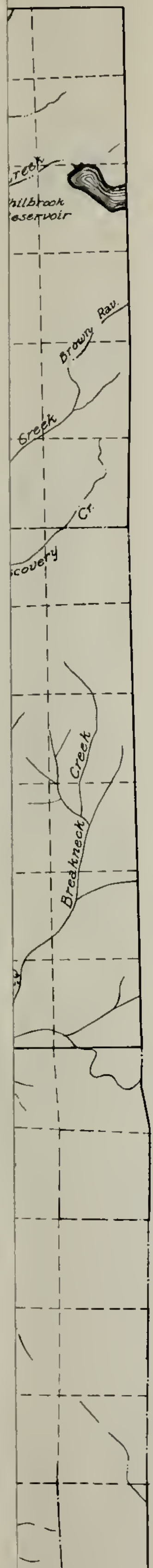
SHEET 22
SHEET 23
SHEET 25
SHEET 27
SHEET 28
MT. DIABLO MERIDIAN



N

LEGEND

CLASS 2

CLASS 3

CLASS 4 - 2

CLASS 4 - 3

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

CLASS 4-2 comprises lands which fail to meet the standards for the preceding land classes, especially with regard to topographic conditions. The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories. Class 4-2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions. Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation. Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops. In coarse-textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops.

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture; however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

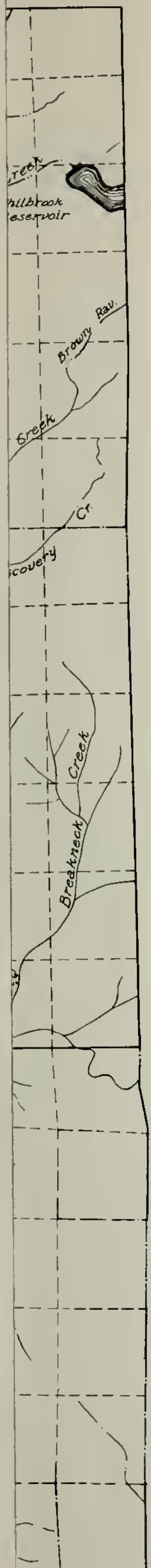
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 1 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



N

LEGEND

	CLASS 2
	CLASS 3
	CLASS 4 - 2
	CLASS 4 - 3
	CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

CLASS 4-2 comprises lands which fail to meet the standards for the preceding land classes, especially with regard to topographic conditions. The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories. Class 4-2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions. Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation. Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops. In coarse-textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops.

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture; however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

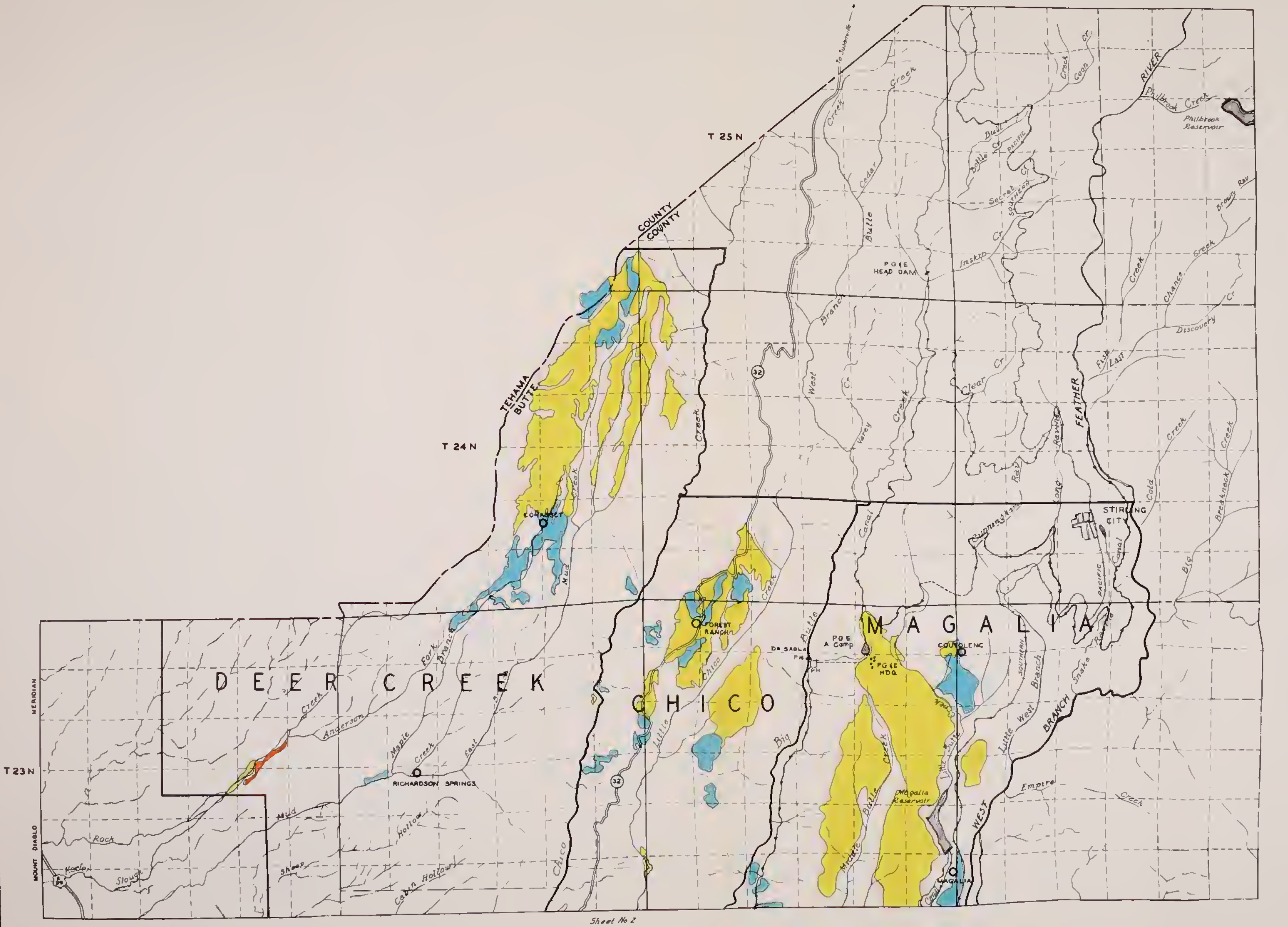
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 1 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

CLASS 2

CLASS 3

CLASS 4 - 2

CLASS 4 - 3

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

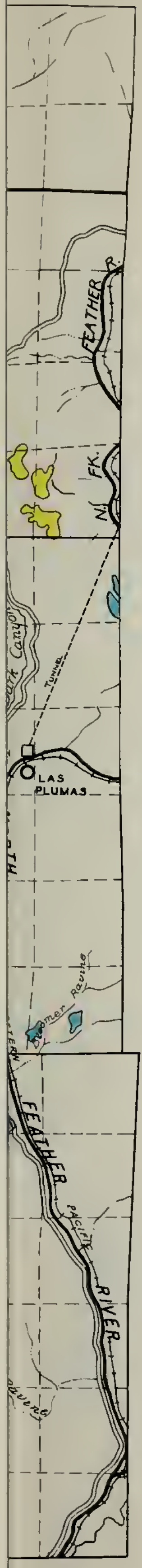
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 1 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

(yellow-green)	CLASS 2
(red)	CLASS 3
(yellow)	CLASS 4-2
(blue)	CLASS 4-3
(grey)	CLASS 5-P
(blank)	CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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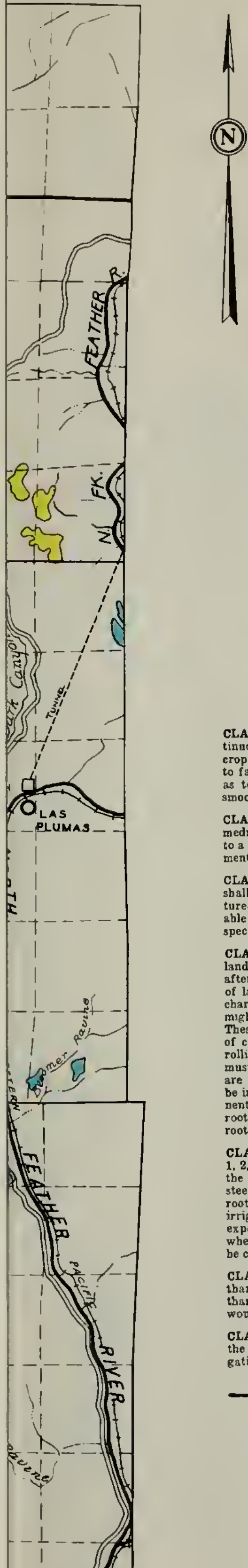
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 2 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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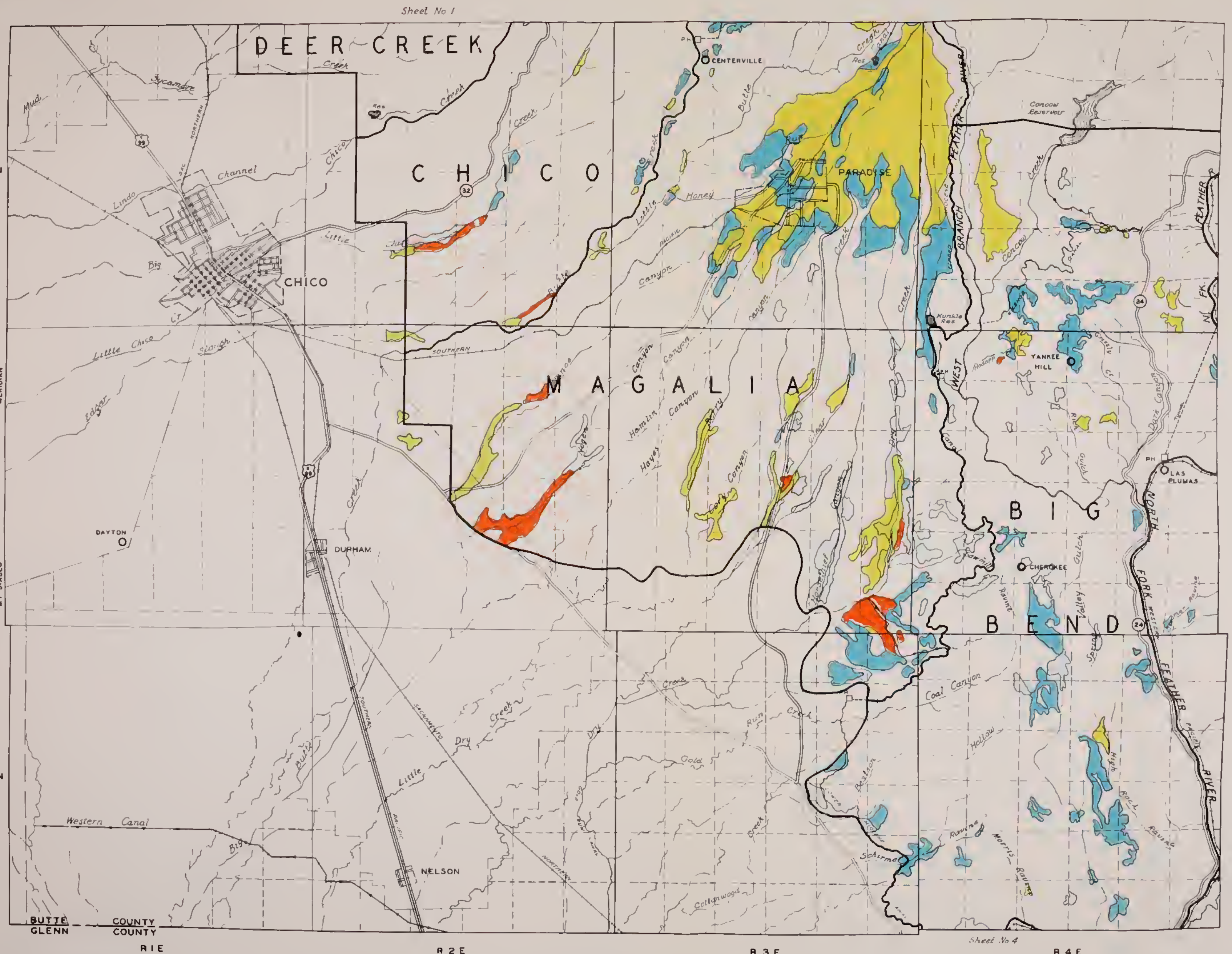
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 2 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

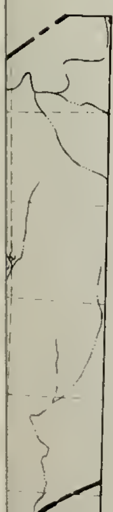
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 2 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

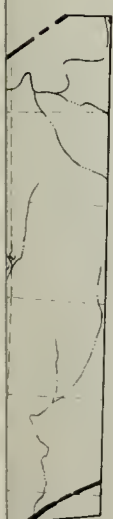
AGRICULTURAL ZONE

1948-1950

SHEET 3 OF 27 SHEETS

SCALE OF MILES

1 0 1 2



LEGEND

- CLASS 2
- CLASS 4-2
- CLASS 4-3
- CLASS 6

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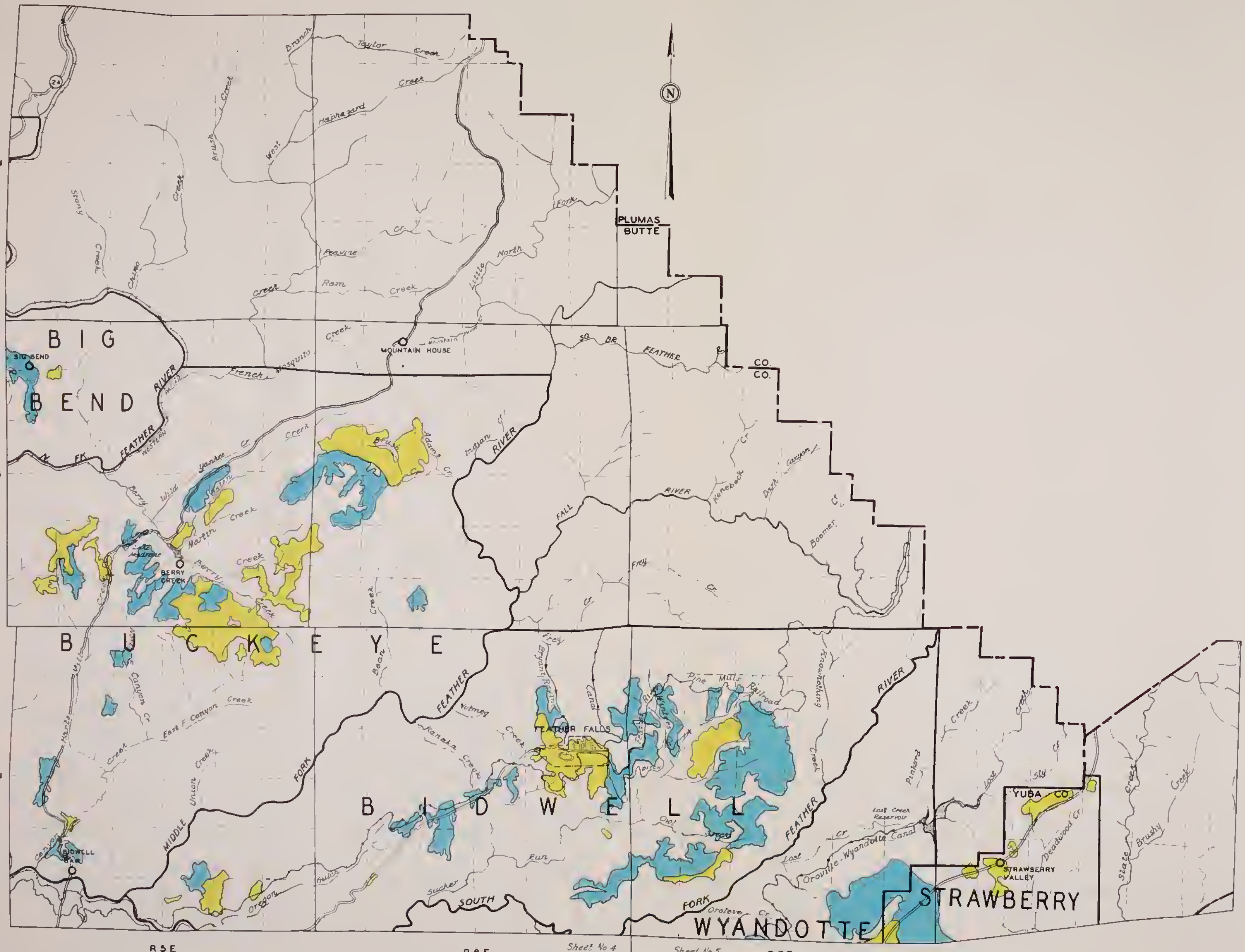
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 3 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

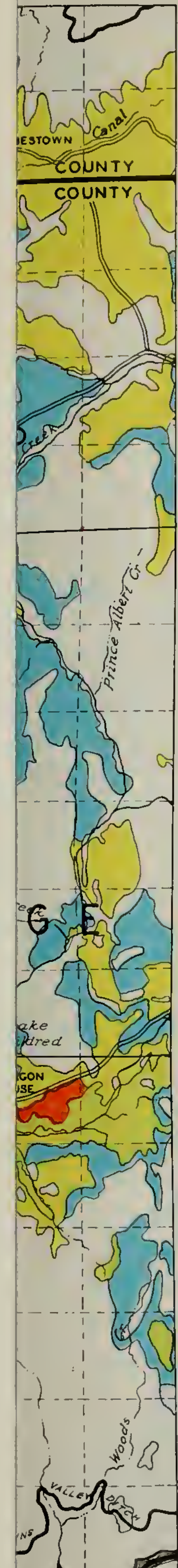
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 3 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

(green)	CLASS 1
(yellow-green)	CLASS 2
(red)	CLASS 3
(yellow)	CLASS 4-2
(blue)	CLASS 4-3
(light grey)	CLASS 5-P
(white)	CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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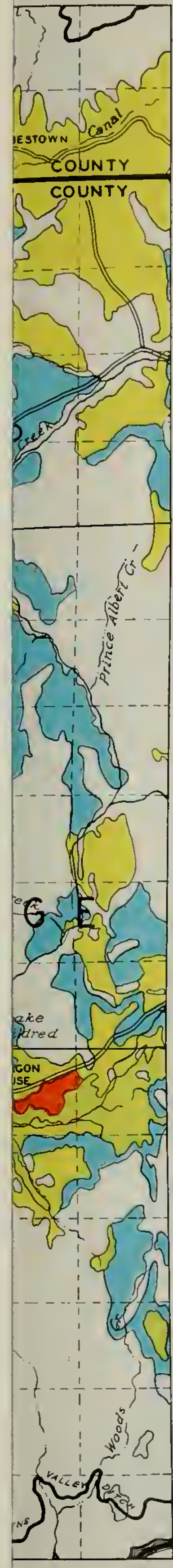
——— WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 4 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

(green)	CLASS 1
(yellow-green)	CLASS 2
(red)	CLASS 3
(yellow)	CLASS 4-2
(blue)	CLASS 4-3
	CLASS 5-P
	CLASS 6

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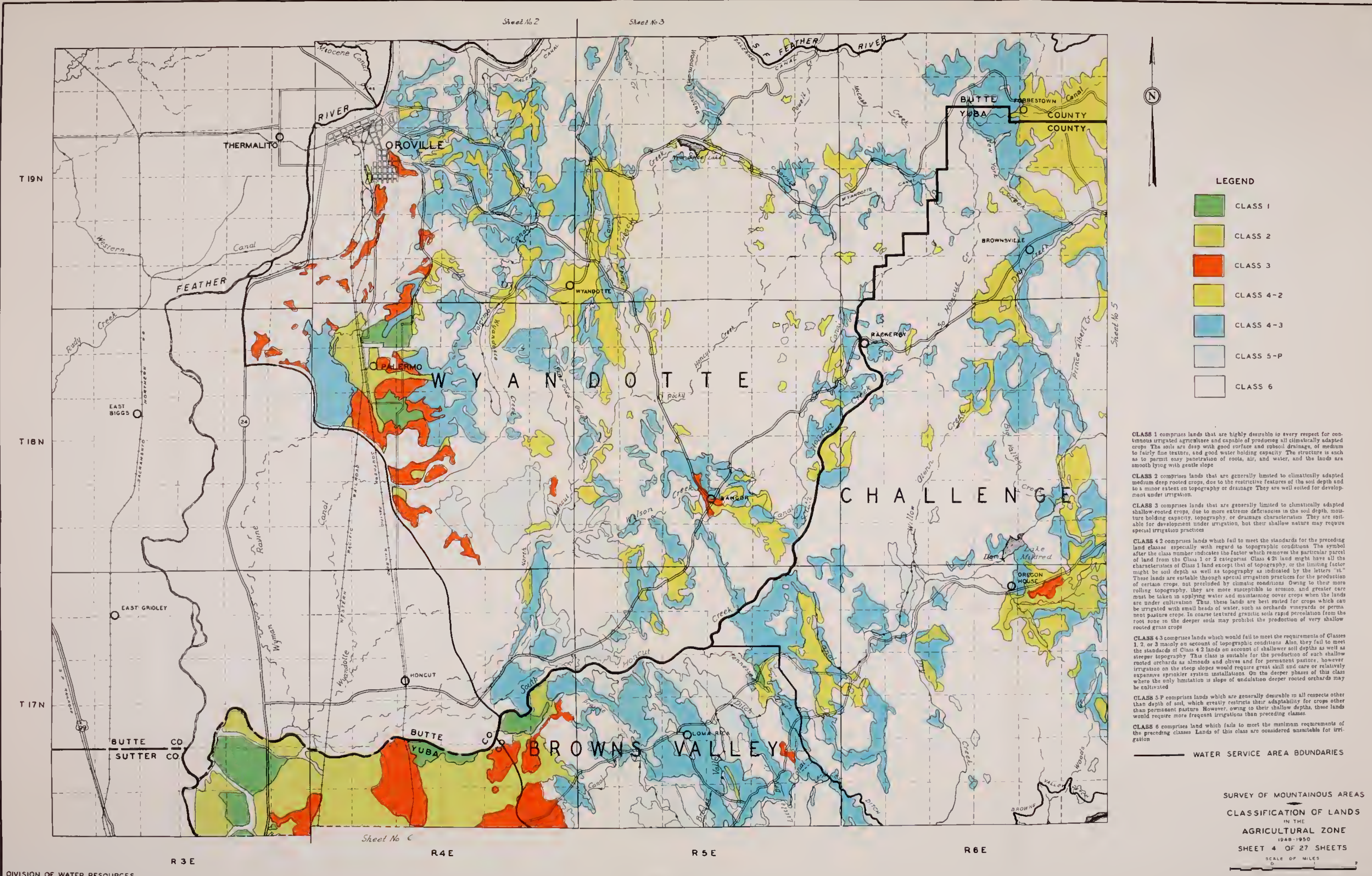
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 4 OF 27 SHEETS

SCALE OF MILES
1 0 1 2


Sheet No 2
Sheet No 3
Sheet No 5
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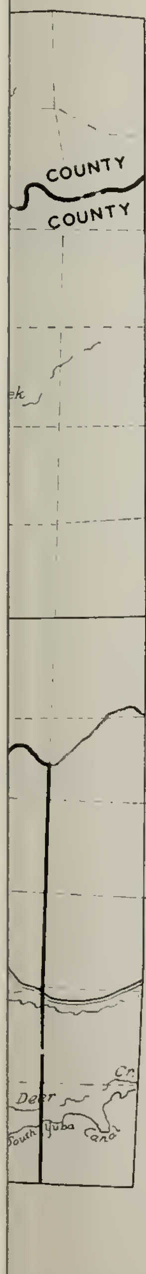
N
OROVILLE
THERMALITO
RIVER
FEATHER
S F FEATHER RIVER
Western Canal
PALERMO
WYANDOTTE
W Y A N D O T T E
C H A L L E N G E
B R O W N S   V A L L E Y
EAST BIGGS
EAST GRIDLEY
HONCUT
BANGOR
RACKERBY
LOMA RICA
BROWNSVILLE
FORBESTOWN
OREGON HOUSE
Lake Mildred
BUTTE COUNTY
YUBA COUNTY
BUTTE CO
SUTTER CO
BUTTE
YUBA
T 19 N
T 18 N
T 17 N
R 3 E
R 4 E
R 5 E
R 6 E
LEGEND
CLASS 1
CLASS 2
CLASS 3
CLASS 4-2
CLASS 4-3
CLASS 5-P
CLASS 6
CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water holding capacity The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope
CLASS 2 comprises lands that are generally limited to climatically adapted medium deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage They are well suited for development under irrigation.
CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture holding capacity, topography, or drainage characteristics They are suitable for development under irrigation, but their shallow nature may require special irrigation practices
CLASS 4 2 comprises lands which fail to meet the standards for the preceding land classes especially with regard to topographic conditions The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories Class 4 2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards vineyards or permanent pasture crops. In coarse textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow rooted grass crops
CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions Also, they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated
CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.
CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation
WATER SERVICE AREA BOUNDARIES
SURVEY OF MOUNTAINOUS AREAS
CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1949-1950
SHEET 4 OF 27 SHEETS
SCALE OF MILES
DIVISION OF WATER RESOURCES



LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 5 OF 27 SHEETS

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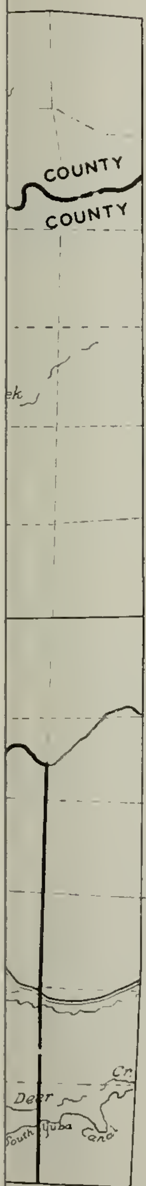

LEGEND

- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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WATER SERVICE AREA BOUNDARIES

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AGRICULTURAL ZONE
1948-1950

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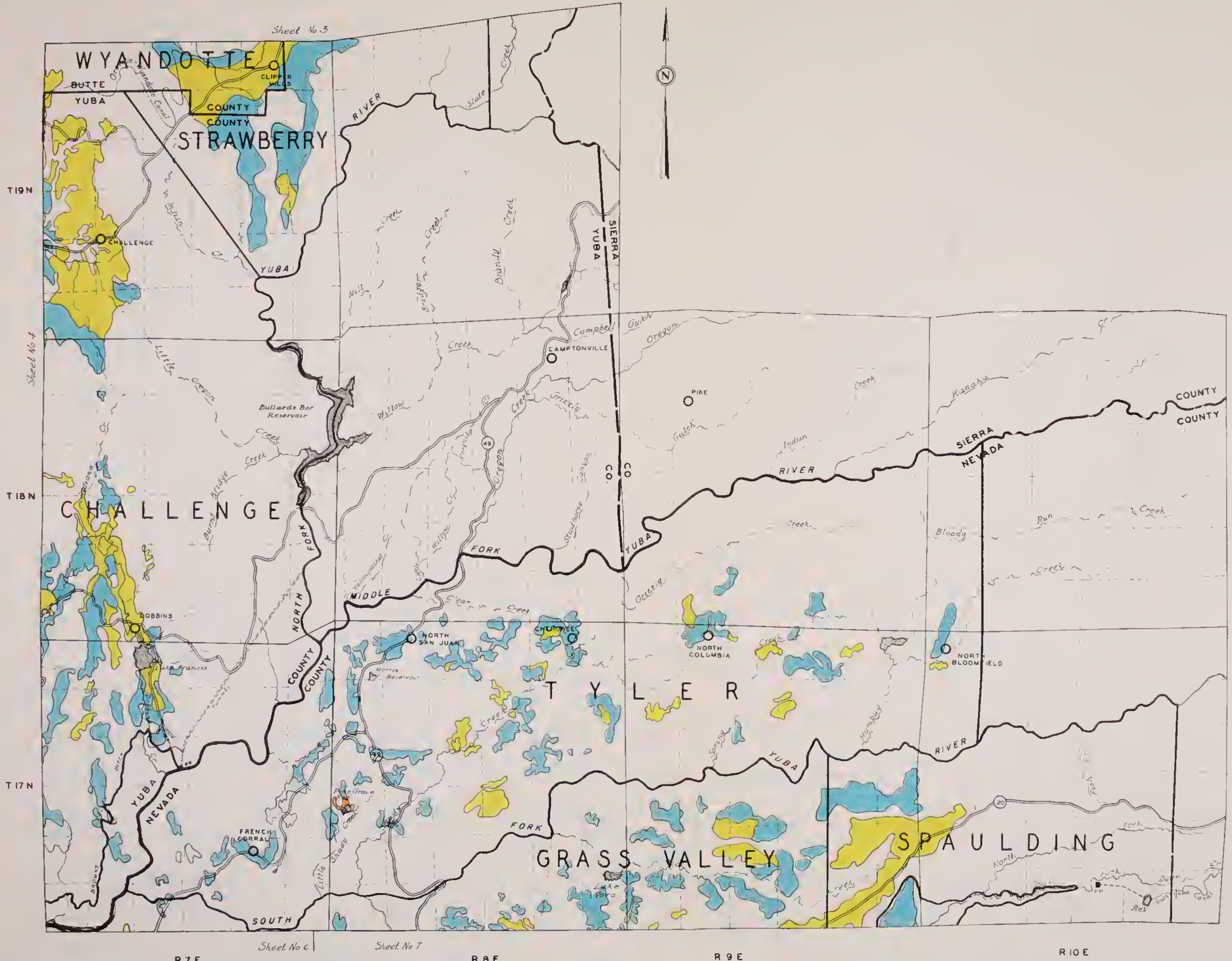

LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

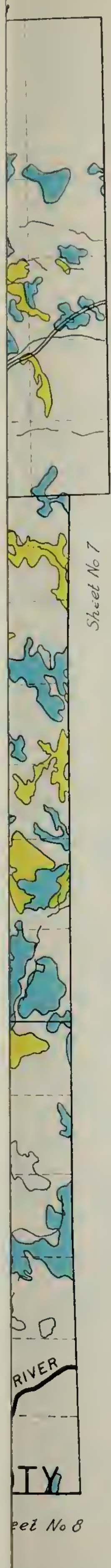
AGRICULTURAL ZONE

1948 1950

SHEET 5 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
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AGRICULTURAL ZONE
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SHEET 6 OF 27 SHEETS

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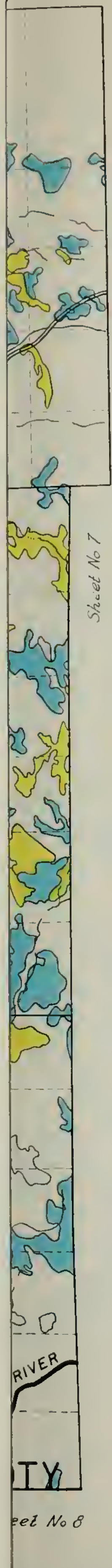

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

AGRICULTURAL ZONE

1948-1950

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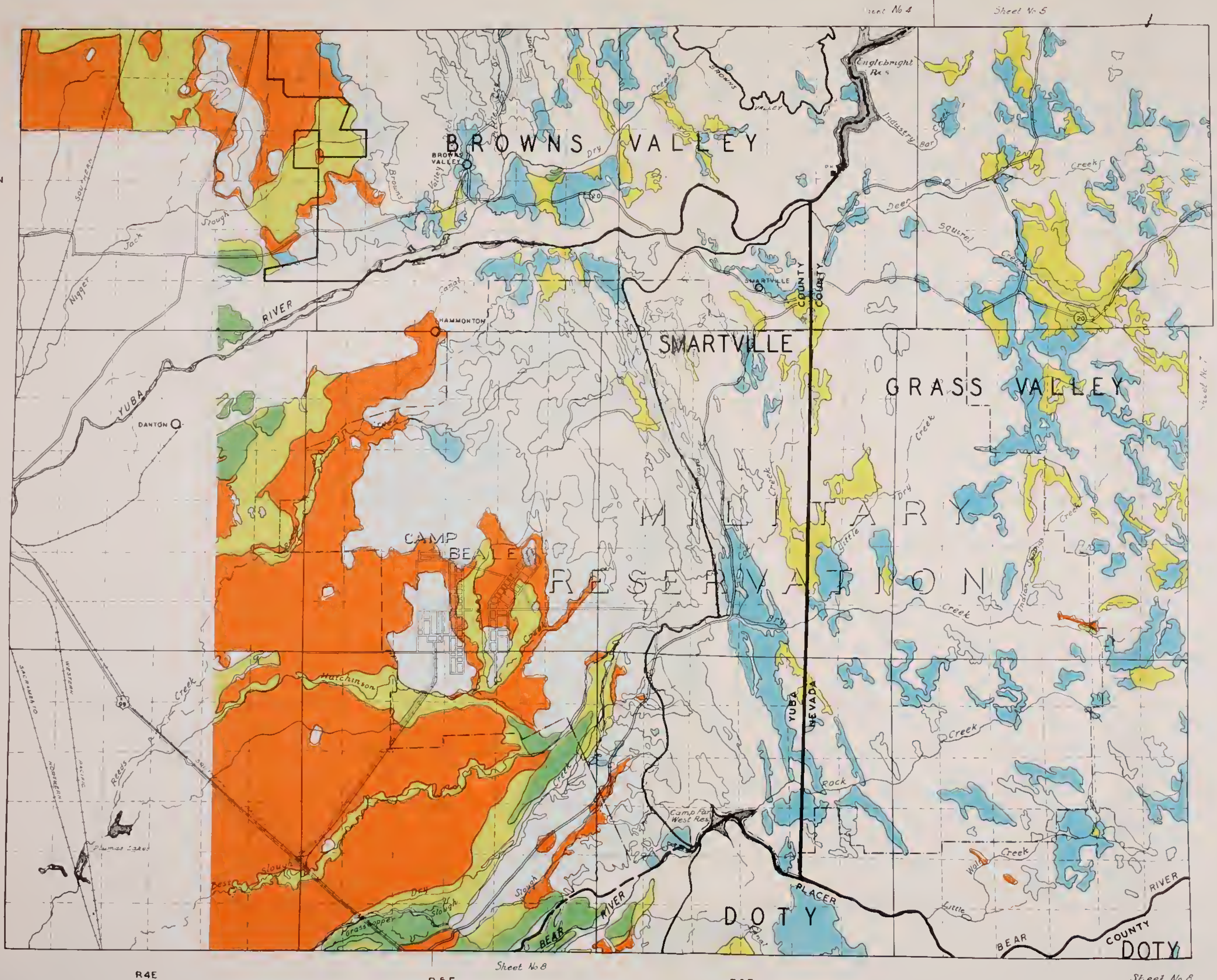

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

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CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

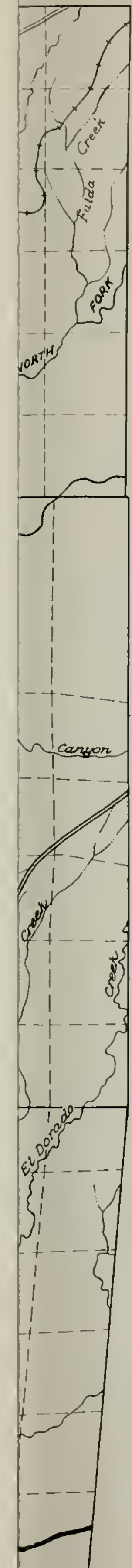
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948 1950

SHEET 6 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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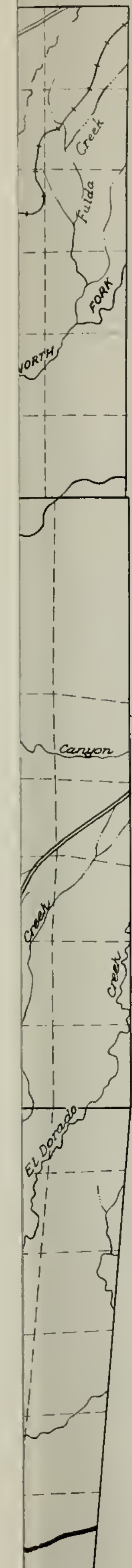

LEGEND

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

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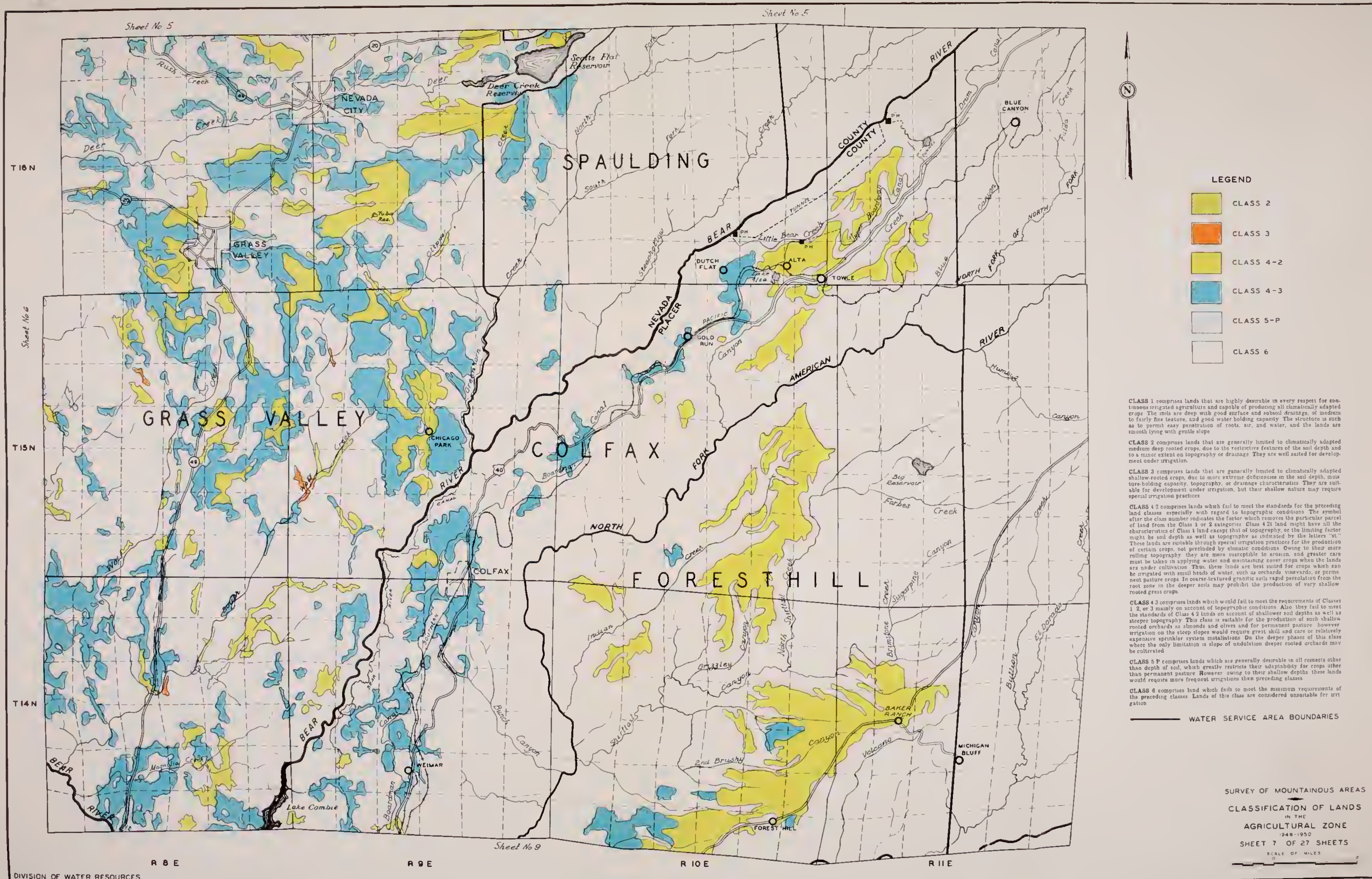
Sheet No 5
Sheet No 5
Sheet No 6
Sheet No 9
T16N
T15N
T14N
R8E
R9E
R10E
R11E
SPAULDING
GRASS VALLEY
COLFAX
FORESTHILL
NEVADA CITY
GRASS VALLEY
CHICAGO PARK
COLFAX
WEIMAR
DUTCH FLAT
ALTA
TOWLE
GOLD RUN
BLUE CANYON
BAKER RANCH
MICHIGAN BLUFF
FOREST HILL
Scotts Flat Reservoir
Deer Creek Reservoir
Lake Combie
Big Reservoir
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COUNTY
COUNTY
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CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water holding capacity The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope
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CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics They are suitable for development under irrigation, but their shallow nature may require special irrigation practices
CLASS 4 2 comprises lands which fail to meet the standards for the preceding land classes especially with regard to topographic conditions The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories Class 4 2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions Owing to their more rolling topography they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards vineyards, or permanent pasture crops In coarse-textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow rooted grass crops.
CLASS 4 3 comprises lands which would fail to meet the requirements of Classes 1 2, or 3 mainly on account of topographic conditions Also they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture however irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated
CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However owing to their shallow depths these lands would require more frequent irrigations than preceding classes.
CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation
WATER SERVICE AREA BOUNDARIES
SURVEY OF MOUNTAINOUS AREAS
CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 7 OF 27 SHEETS
SCALE OF MILES
DIVISION OF WATER RESOURCES

LEGEND

CLASS I

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

LASS 1 comprises lands that are highly desirable in every respect for con-nuous irrigated agriculture and capable of producing all climatically adapted ops. The soils are deep with good surface and subsoil drainage, of medium fairly fine texture, and good water-holding capacity. The structure is such to permit easy penetration of roots, air, and water, and the lands are nooth lying with gentle slope

LASS 2 comprises lands that are generally limited to climatically adapted edium-deep rooted crops, due to the restrictive features of the soil depth and a minor extent on topography or drainage They are well suited for develop-ent under irrigation.

LASS 3 comprises lands that are generally limited to climatically adapted allow-rooted crops, due to more extreme deficiencies in the soil depth, mois-re-holding capacity, topography, or drainage characteristics. They are suit-ble for development under irrigation, but their shallow nature may require ecial irrigation practices.

LASS 4-2 comprises lands which fail to meet the standards for the preceding nd classes, especially with regard to topographic conditions. The symbol ter the class number indicates the factor which removes the particular parcel land from the Class 1 or 2 categories. Class 4-2t land might have all the aracteristics of Class 1 land except that of topography, or the limiting factor ight be soil depth as well as topography as indicated by the letters "st." hese lands are suitable through special irrigation practices for the production certain crops, not precluded by climatic conditions. Owing to their more lling topography, they are more susceptible to erosion, and greater care ust be taken in applying water and maintaining cover crops when the lands e under cultivation. Thus, these lands are best suited for crops which can irrigated with small heads of water, such as orchards, vineyards, or perma-ent pasture crops In coarse textured granitic soils rapid percolation from the ot zone in the deeper soils may prohibit the production of very shallow-oted grass crops.

LASS 4-3 comprises lands which would fail to meet the requirements of Classes 2, or 3 mainly on account of topographic conditions Also, they fail to meet e standards of Class 4 2 lands on account of shallower soil depths as well as eeper topography This class is suitable for the production of such shallow oted orchards as almonds and olives and for permanent pasture; however, rigation on the steep slopes would require great skill and care or relatively pensive sprinkler system installations On the deeper phases of this class here the only limitation is slope of undulation deeper rooted orchards may cultivated

LASS 5 P comprises lands which are generally desirable in all respects other an depth of soil, which greatly restricts their adaptability for crops other an permanent pasture However, owing to their shallow depths, these lands ould require more frequent irrigations than preceding classes

LASS 6 comprises land which fails to meet the minimum requirements of e preceding classes. Lands of this class are considered unsuitable for irri-ation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AR

CLASSIFICATION OF LAN

IN THE

AGRICULTURAL ZONE

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SCALE OF MILES

0

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

LASS 1 comprises lands that are highly desirable in every respect for con-
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fairly fine texture, and good water-holding capacity. The structure is such
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AR

CLASSIFICATION OF LAN

IN THE

AGRICULTURAL ZONE

1948-1950

SHEET 8 OF 27 SHEETS

SCALE OF MILES

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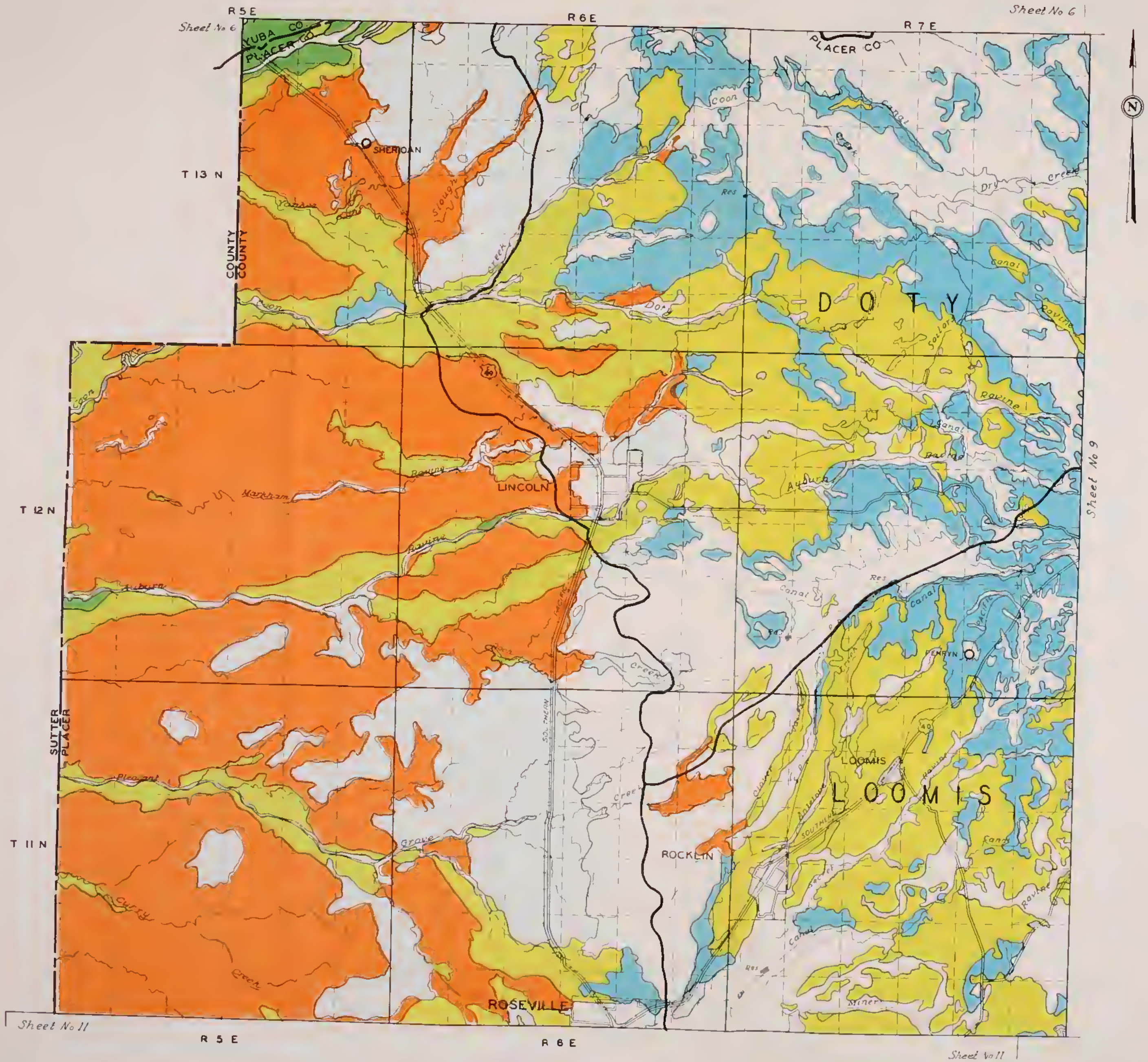

LEGEND

	CLASS 1
	CLASS 2
	CLASS 3
	CLASS 4-2
	CLASS 4-3
	CLASS 5-P
	CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture and good water holding capacity The structure is such as to permit easy penetration of roots air and water and the lands are smooth lying with gentle slope

CLASS 2 comprises lands that are generally limited to climatically adapted medium deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage They are well suited for development under irrigation

CLASS 3 comprises lands that are generally limited to climatically adapted shallow rooted crops, due to more extreme deficiencies in the soil depth, moisture holding capacity topography, or drainage characteristics They are suitable for development under irrigation but their shallow nature may require special irrigation practices

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CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

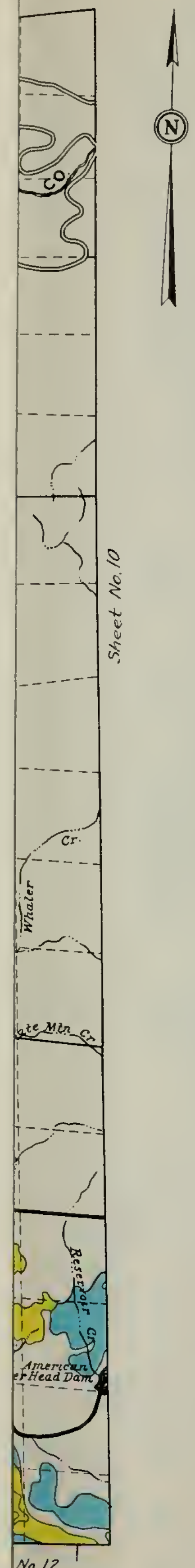
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 8 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

CLASS 2

CLASS 3

CLASS 4 – 2

CLASS 4 – 3

CLASS 5 – P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

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CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture; however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

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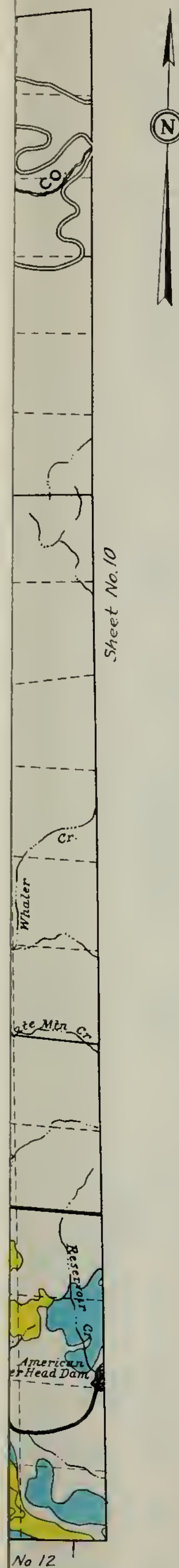
SCALE OF MILES

1 0 1 2



LEGEND

CLASS 2

CLASS 3

CLASS 4 – 2

CLASS 4 – 3

CLASS 5 – P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, aod water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, doe to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristica. They are suitable for development under irrigation, hut their shallow nature may require special irrigation practices.

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CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture; however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may he cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948–1950

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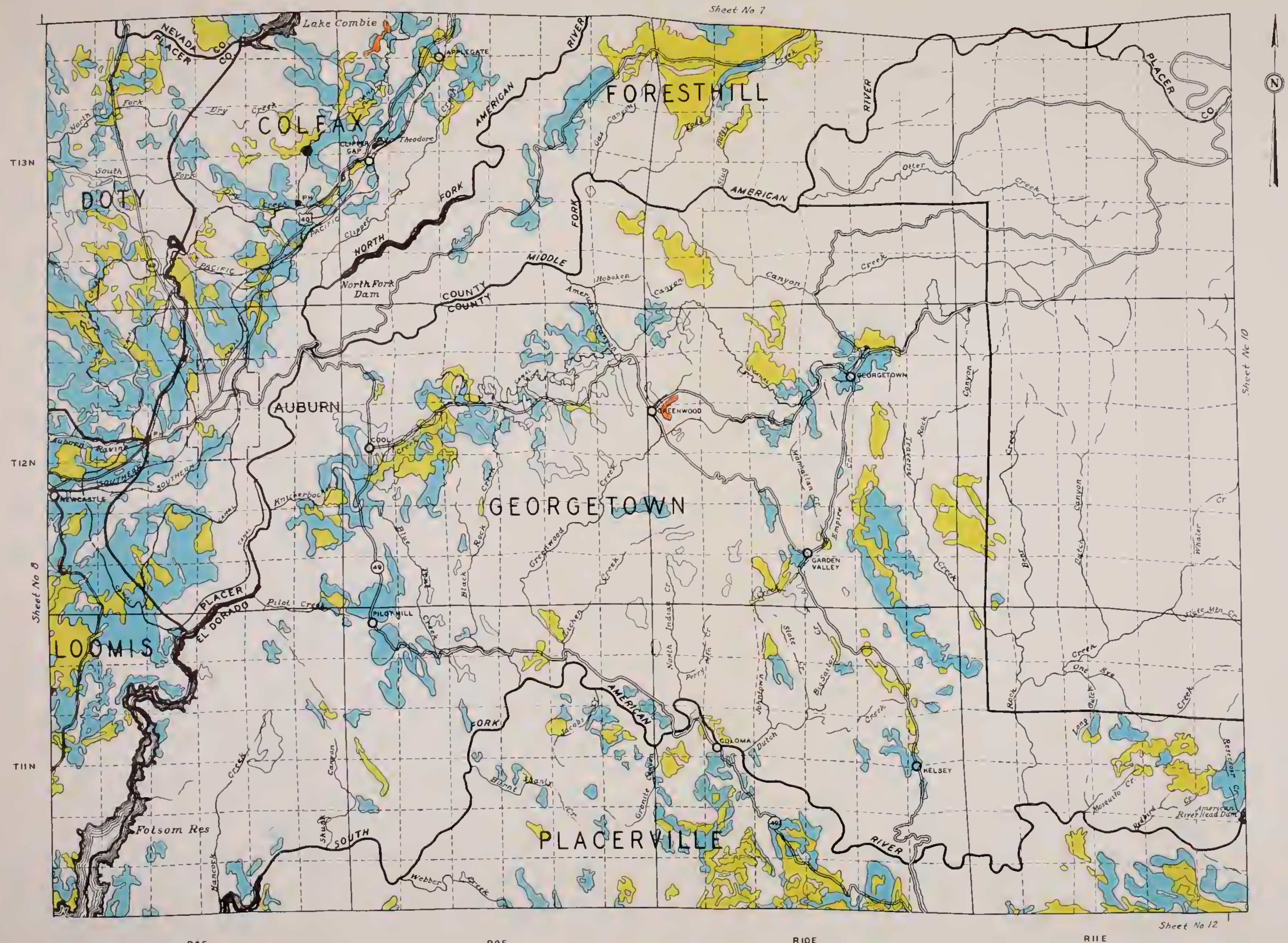
SCALE OF MILES
1 0 1 2



LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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CLASS 4 3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

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IN THE
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LEGEND

CLASS 4-2

CLASS 4-3

CLASS 6

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

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1 0 1 2

LEGEND

CLASS 4-2

CLASS 4-3

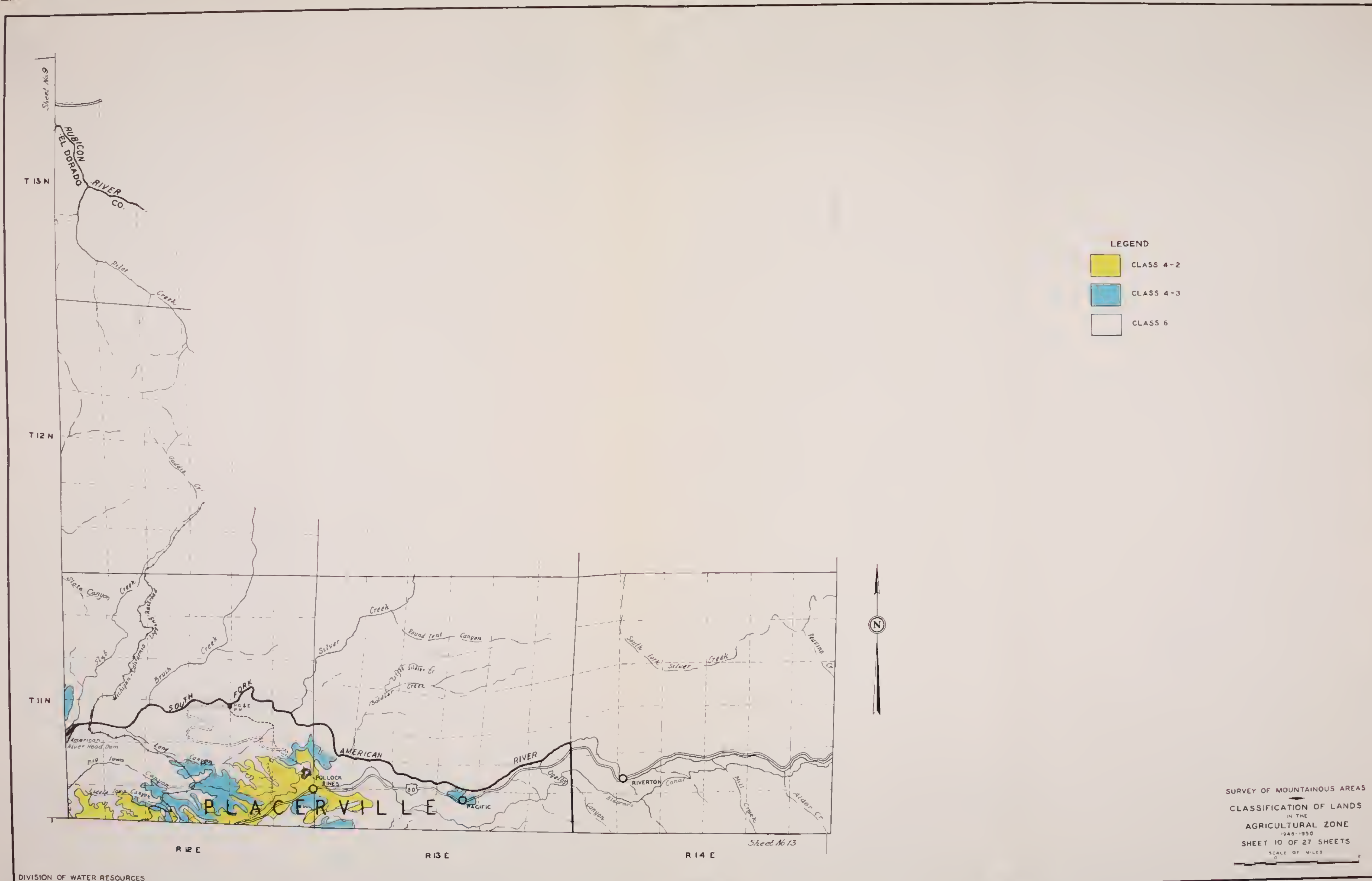
CLASS 6

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 10 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND
CLASS 4-2
CLASS 4-3
CLASS 6
Sheet No. 9
RUBICON
EL DORADO
RIVER
CO.
T 13 N
T 12 N
T 11 N
Pilot Creek
State Canyon Creek
Slab
Brush Creek
Silver Creek
Round Tent Canyon
SOUTH FORK
AMERICAN RIVER
American River Head Dam
Long Canyon
Big Iowa Canyon
PLACERVILLE
POLLOCK PINES
PACIFIC
RIVERTON
50
South Fork Silver Creek
Mill Creek
Alder Cr
Sheet No. 13
R 12 E
R 13 E
R 14 E
SURVEY OF MOUNTAINOUS AREAS
CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
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SCALE OF MILES
DIVISION OF WATER RESOURCES

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

AGRICULTURAL ZONE

1948-1950

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SCALE OF MILES

1 0 1 2

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

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CLASSIFICATION OF LANDS
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AGRICULTURAL ZONE
1948-1950

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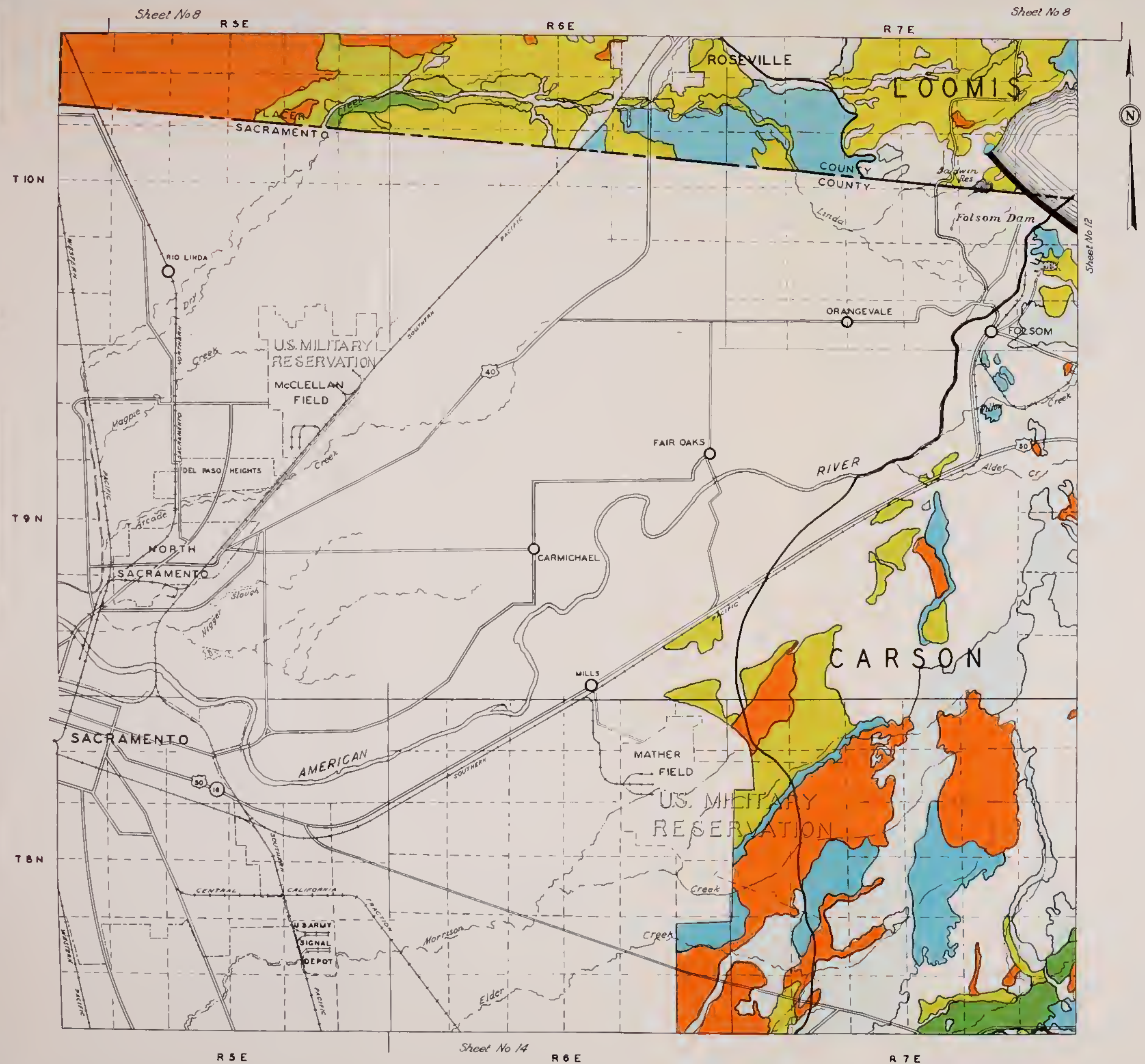

LEGEND

CLASS 1
CLASS 2
CLASS 3
CLASS 4-2
CLASS 4-3
CLASS 5-P
CLASS 6

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CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions Also, they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However, owing to their shallow depths these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

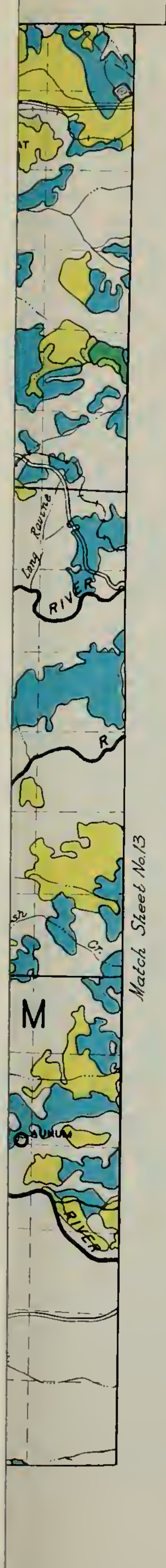
SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 11 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

(dark green)	CLASS 1
(light green)	CLASS 2
(orange)	CLASS 3
(yellow)	CLASS 4-2
(blue)	CLASS 4-3
(pale blue)	CLASS 5-P
(white)	CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

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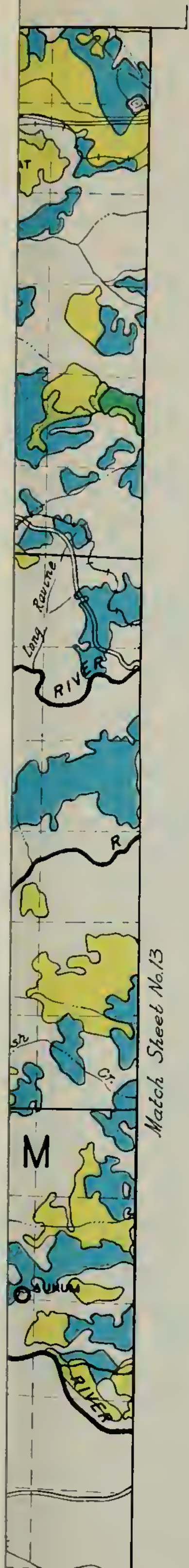
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 12 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 12 OF 27 SHEETS

SCALE OF MILES
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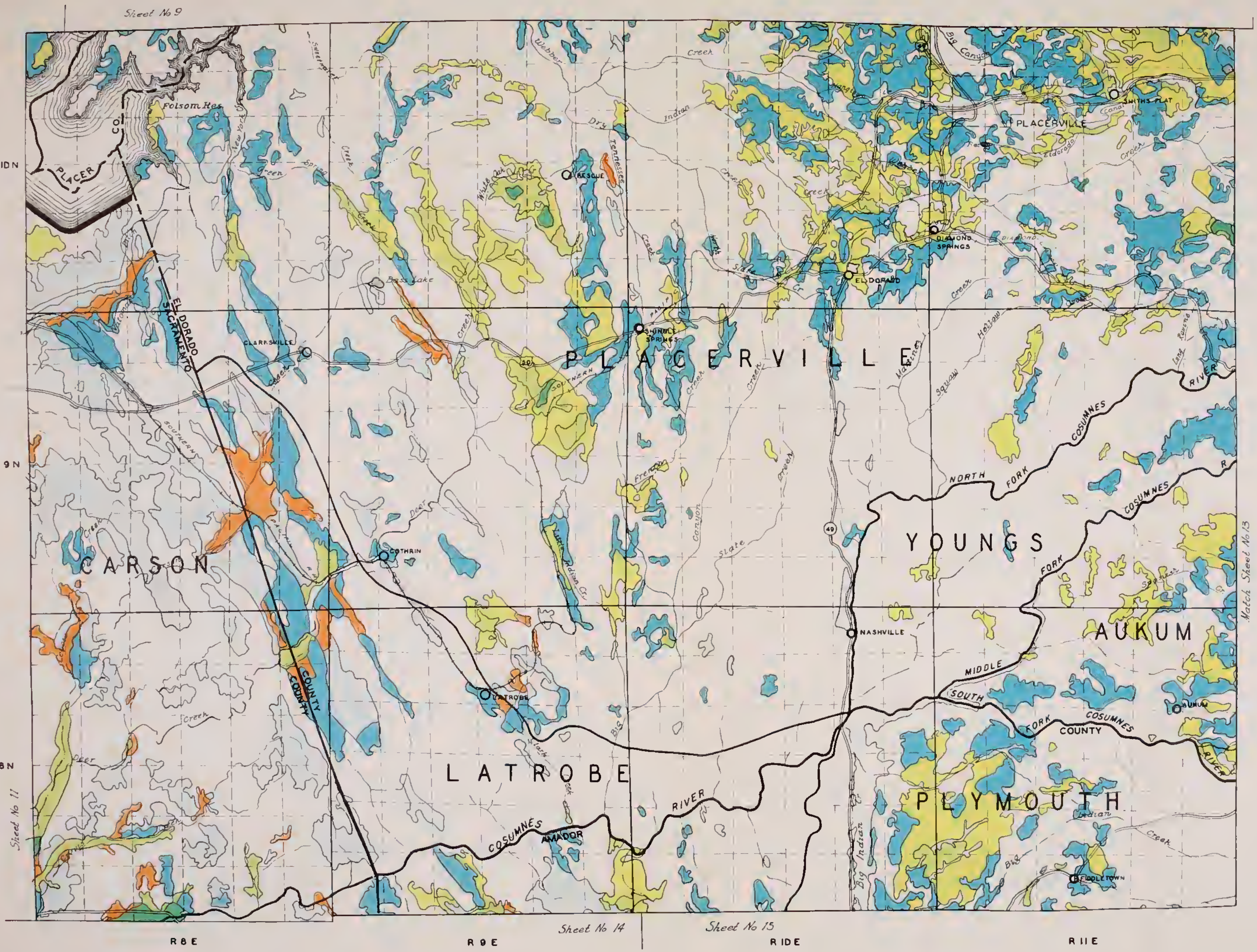

LEGEND

- CLASS 1
- CLASS 2
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1946-1950

SHEET 12 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES

LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 13 OF 27 SHEETS

SCALE OF MILES
1 0 1 2

LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 6

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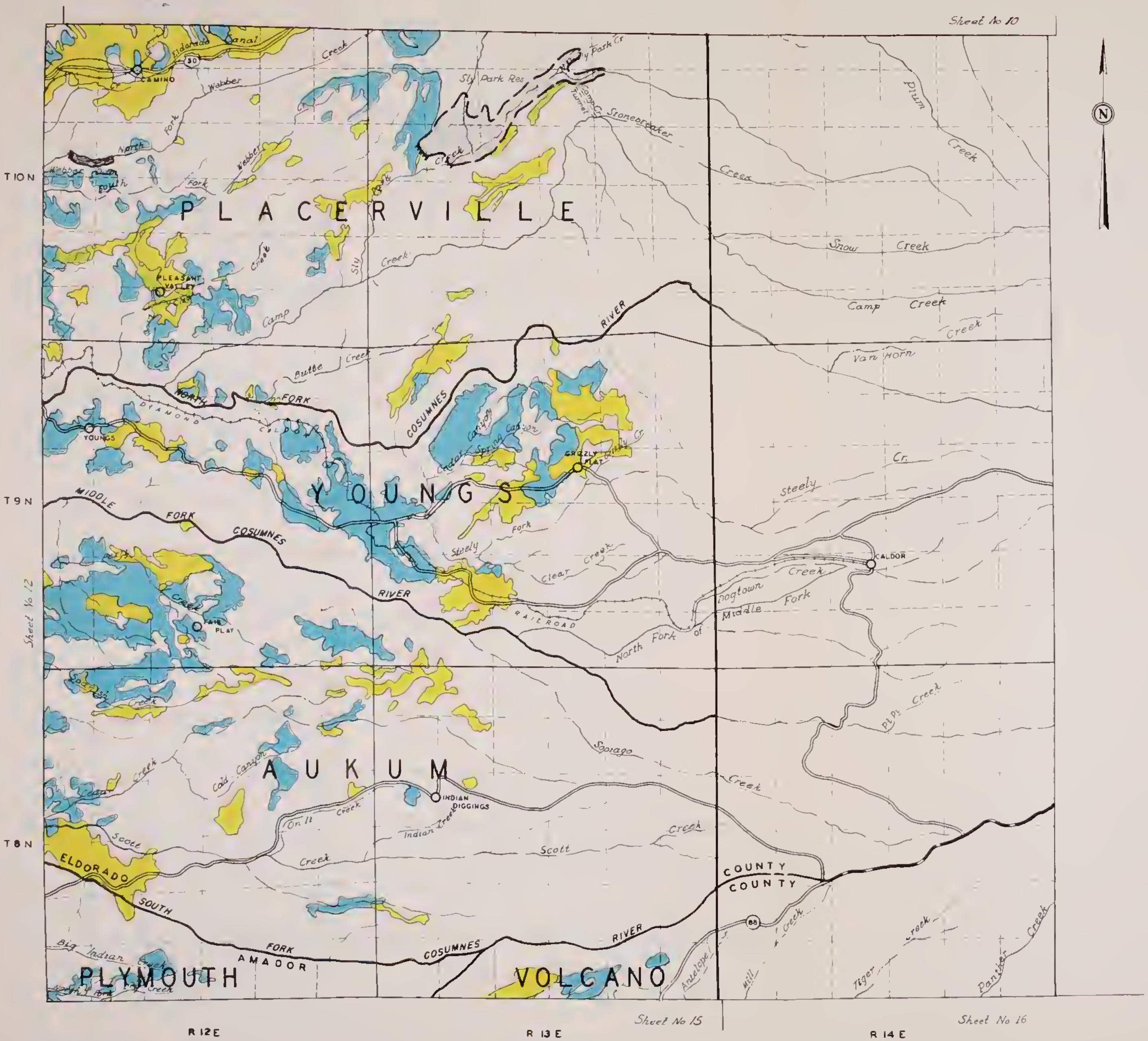
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 13 OF 27 SHEETS

SCALE OF MILES
0 1 2



LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

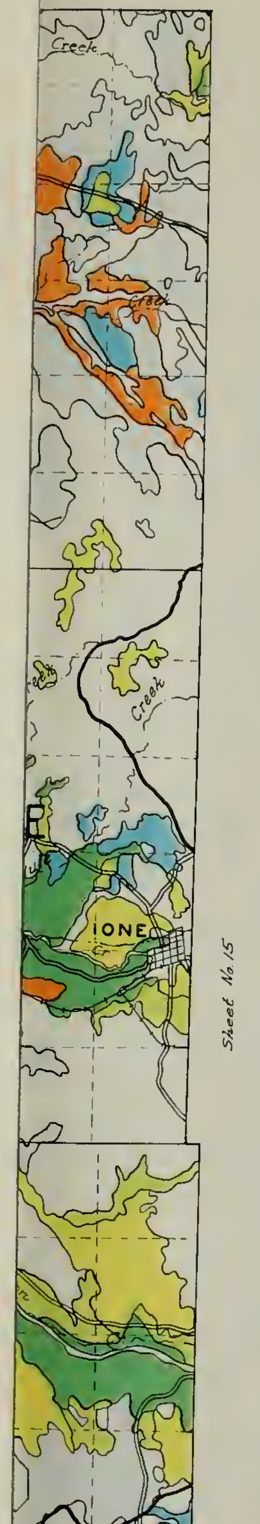
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 13 OF 27 SHEETS

SCALE OF MILES

IVISION OF WATER RESOURCES



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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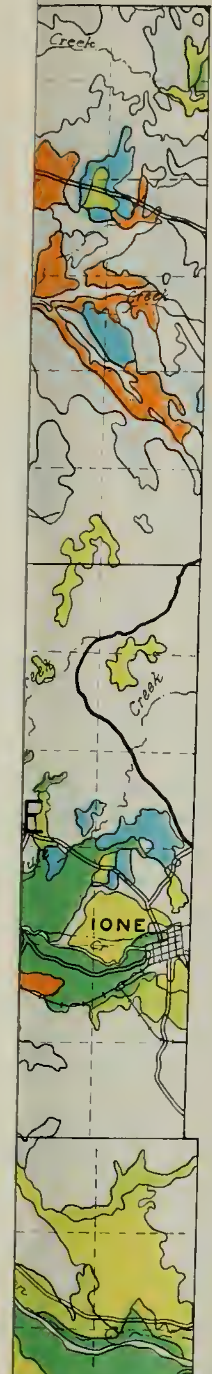
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 14 OF 27 SHEETS

SCALE OF MILES
0 1 2



LEGEND

- CLASS 1
- CLASS 2
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- CLASS 4-2
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- CLASS 5-P
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
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SHEET 14 OF 27 SHEETS

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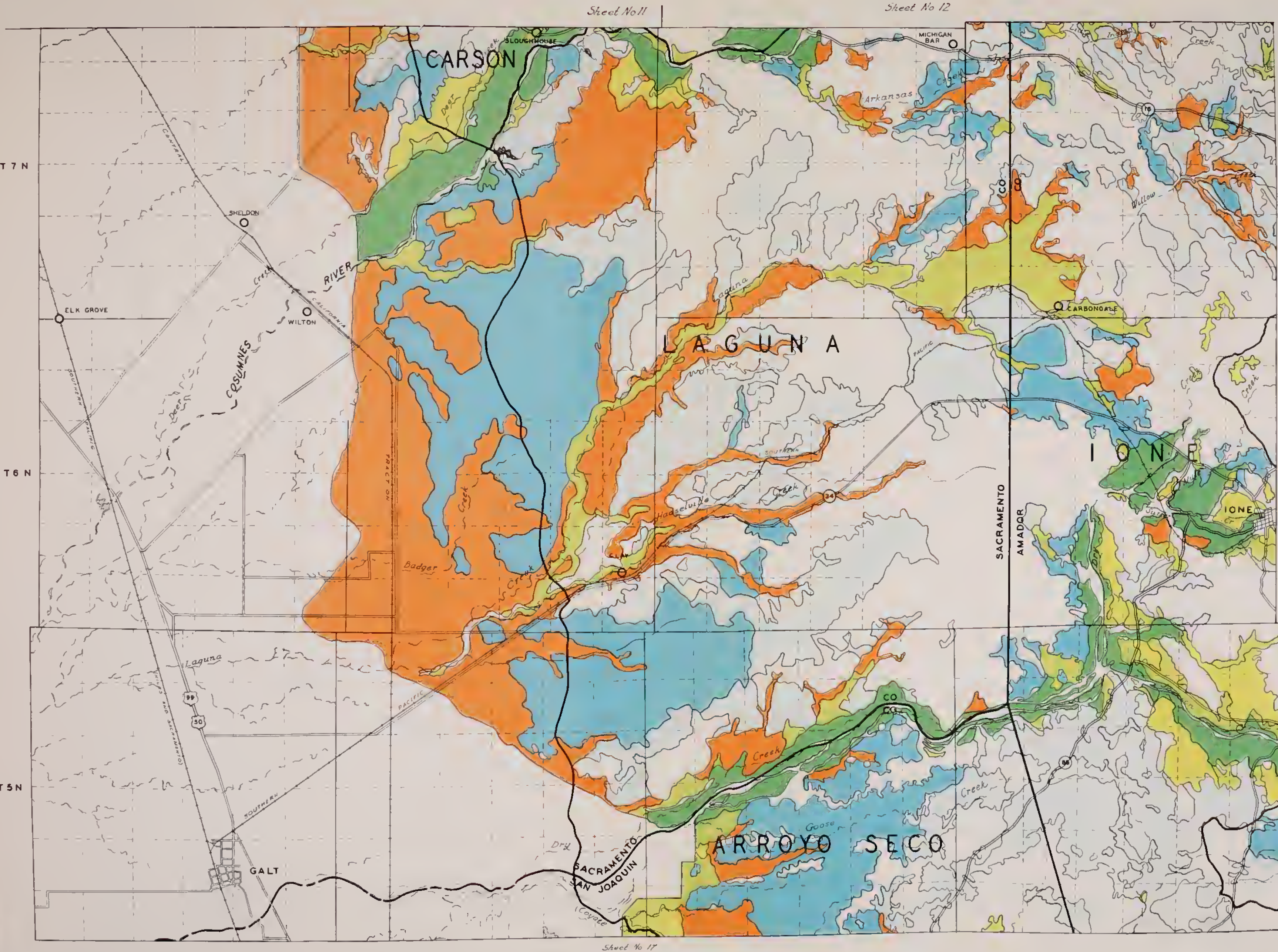

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

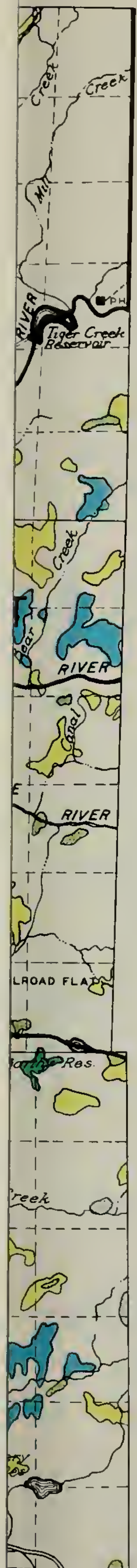
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 14 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



Sheet No 16

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

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CLASS 4-2 comprises lands which fail to meet the standards for the preceding land classes, especially with regard to topographic conditions. The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories. Class 4-2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions. Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation. Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops. In coarse-textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops.

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions. Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography. This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture; however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations. On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture. However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

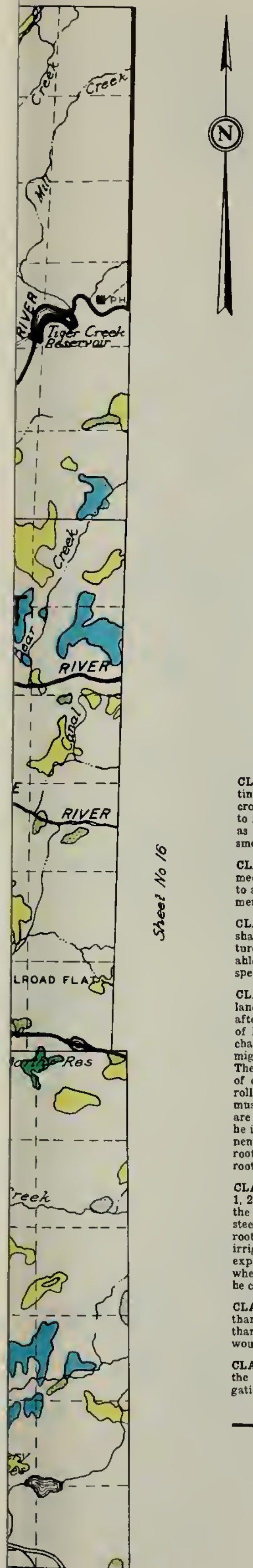
CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 15 OF 27 SHEETS

SCALE OF MILES
0 1 2



LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 15 OF 27 SHEETS

SCALE OF MILES
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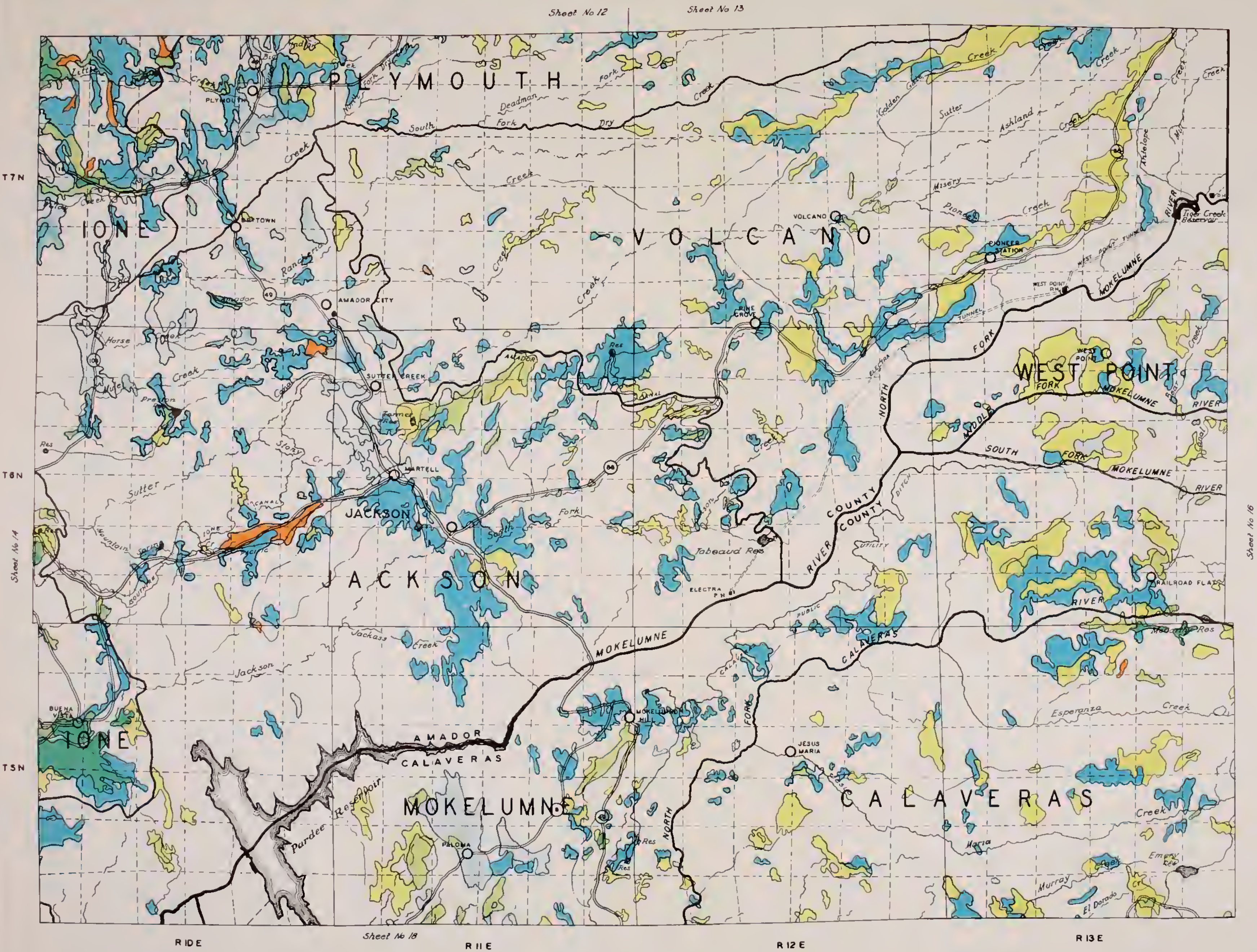

LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 15 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES

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BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 16 OF 27 SHEETS

SCALE OF MILES
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BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

AGRICULTURAL ZONE

1948-1950

SHEET 16 OF 27 SHEETS

SCALE OF MILES

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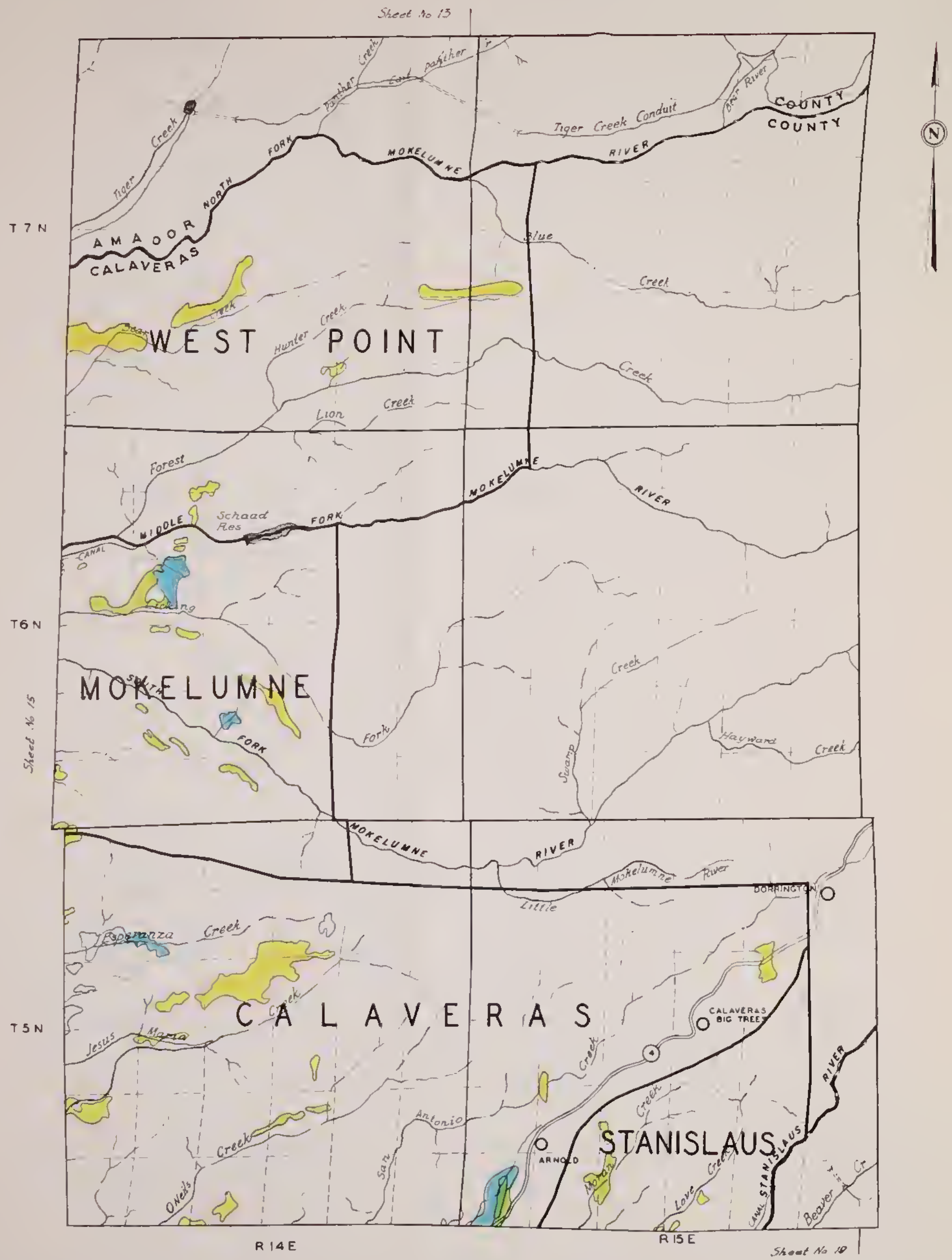

LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water holding capacity The structure is such as to permit easy penetration of roots air, and water, and the lands are smooth lying with gentle slope

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CLASS 4 3 comprises lands which would fail to meet the requirements of Classes 1 2, or 3 mainly on account of topographic conditions Also, they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated

CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However owing to their shallow depths, these lands would require more frequent irrigations than preceding classes

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

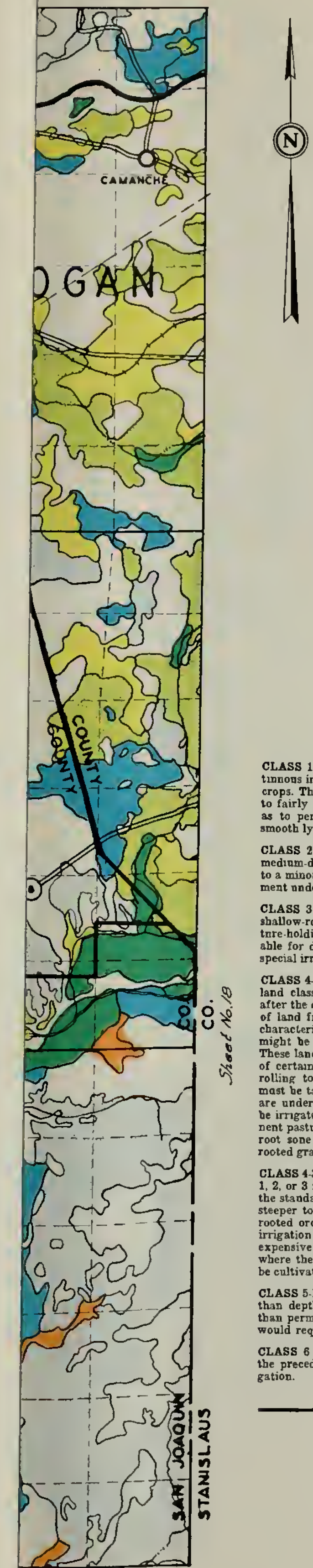
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1946-1950
SHEET 16 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



Sheet No 20

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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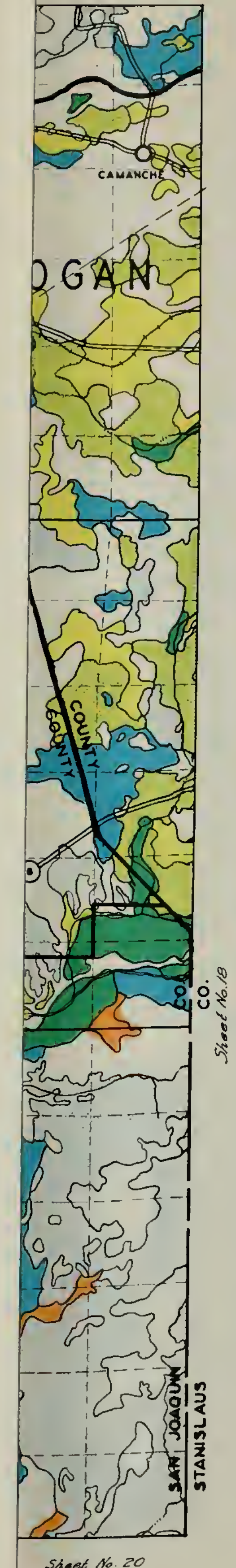
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 17 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



N

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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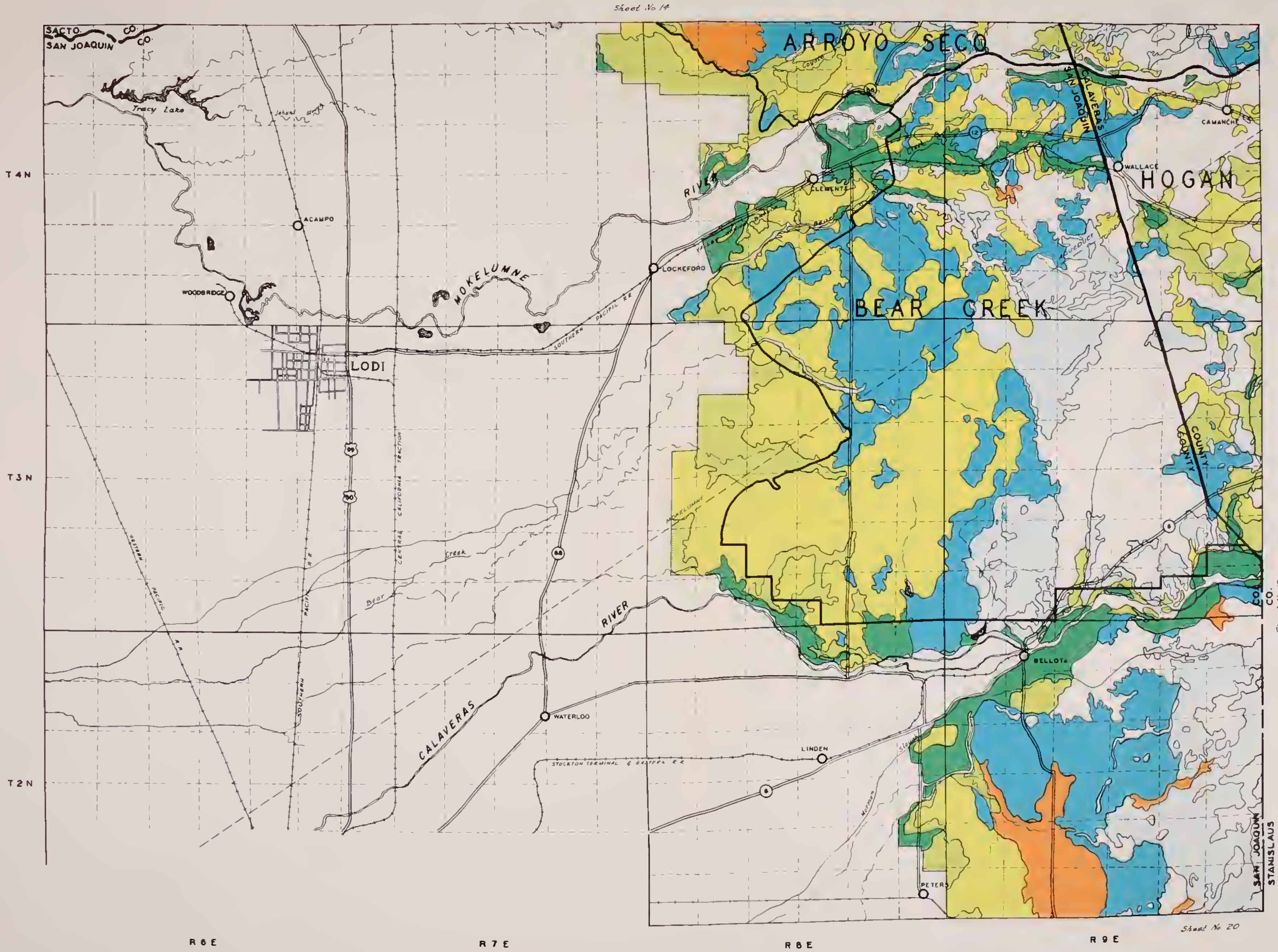
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 17 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
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- CLASS 4-3
- CLASS 5-P
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

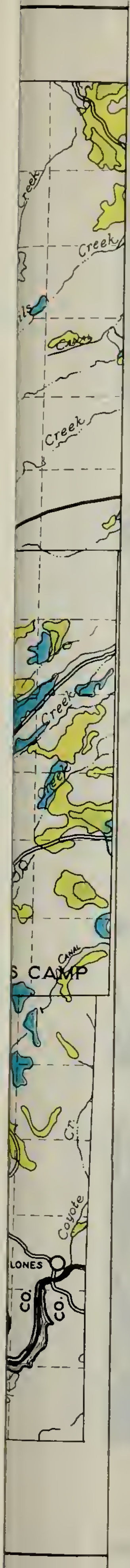
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 17 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES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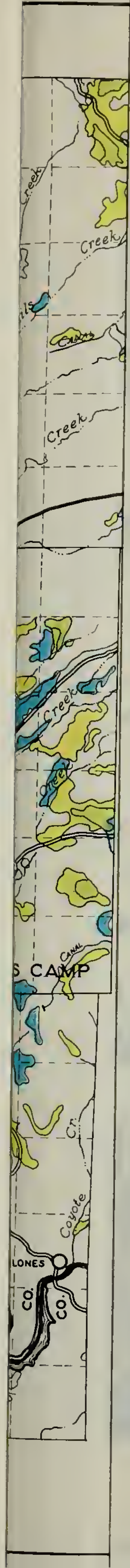

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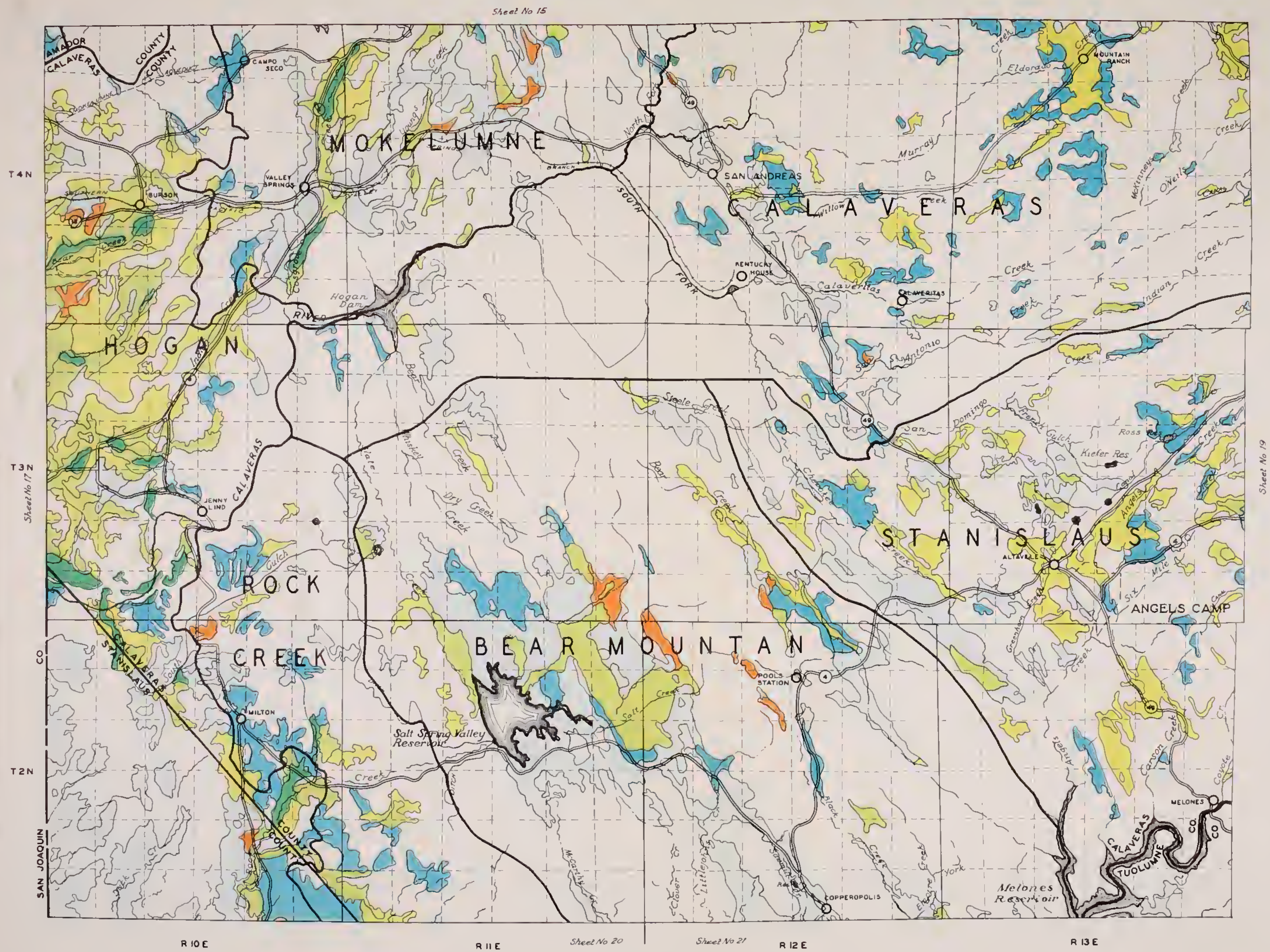

LEGEND

- CLASS 1
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CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

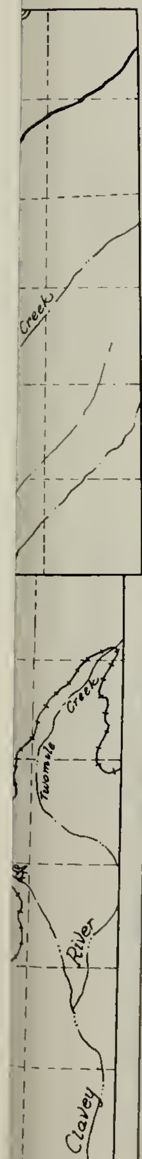
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 18 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



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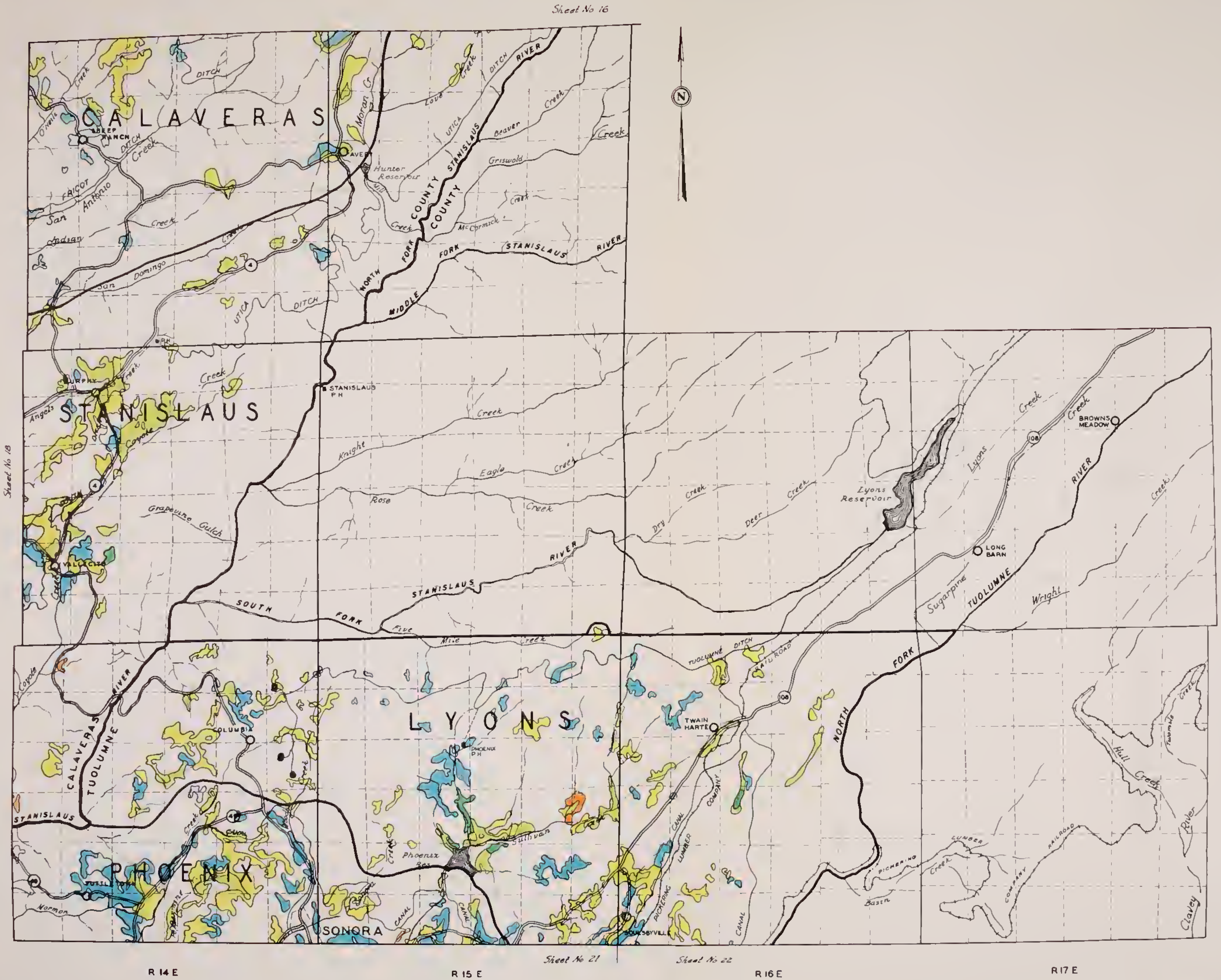
River
Clavey



LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture and good water-holding capacity The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope

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CLASS 3 comprises lands that are generally limited to climatically adapted shallow rooted crops, due to more extreme deficiencies in the soil depth, moisture holding capacity topography, or drainage characteristics They are suitable for development under irrigation, but their shallow nature may require special irrigation practices

CLASS 4 2 comprises lands which fail to meet the standards for the preceding land classes, especially with regard to topographic conditions. The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories Class 4 2t land might have all the characteristics of Class 1 land except that of topography or the limiting factor might be soil depth as well as topography as indicated by the letters "st" These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops In coarse textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions Also, they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however, irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

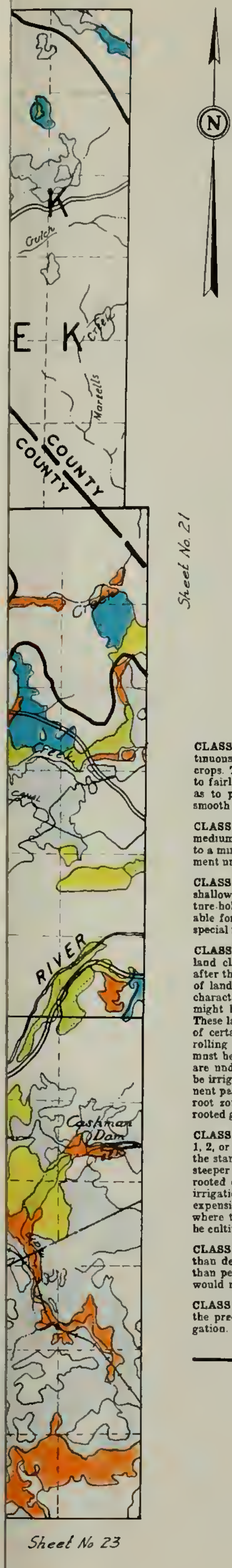
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 19 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage. They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

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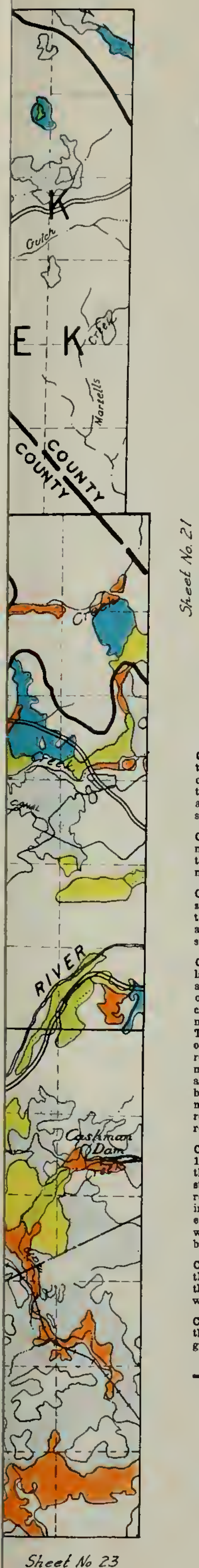
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 20 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

- CLASS 1
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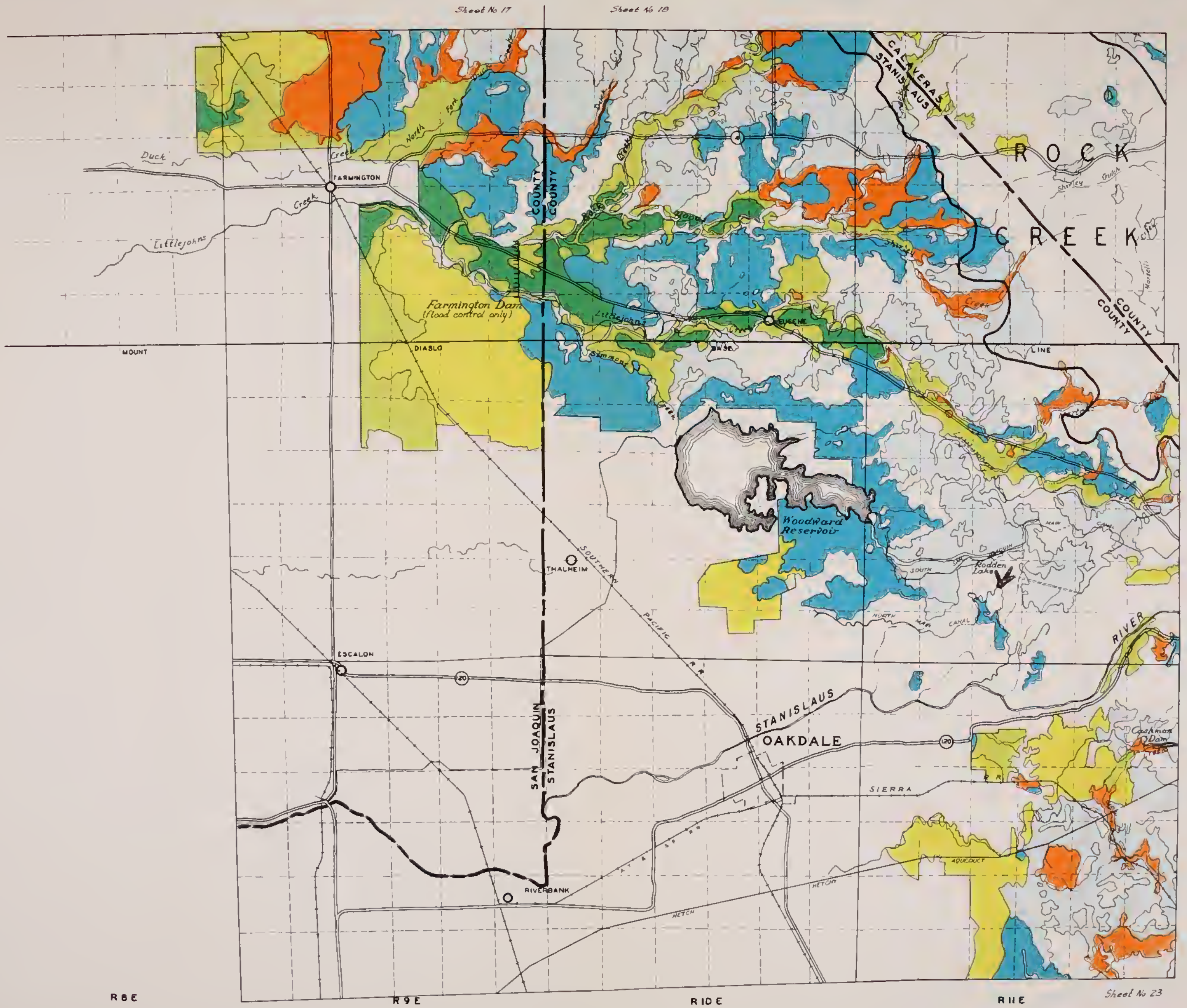
——— WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 20 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

- CLASS 1
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

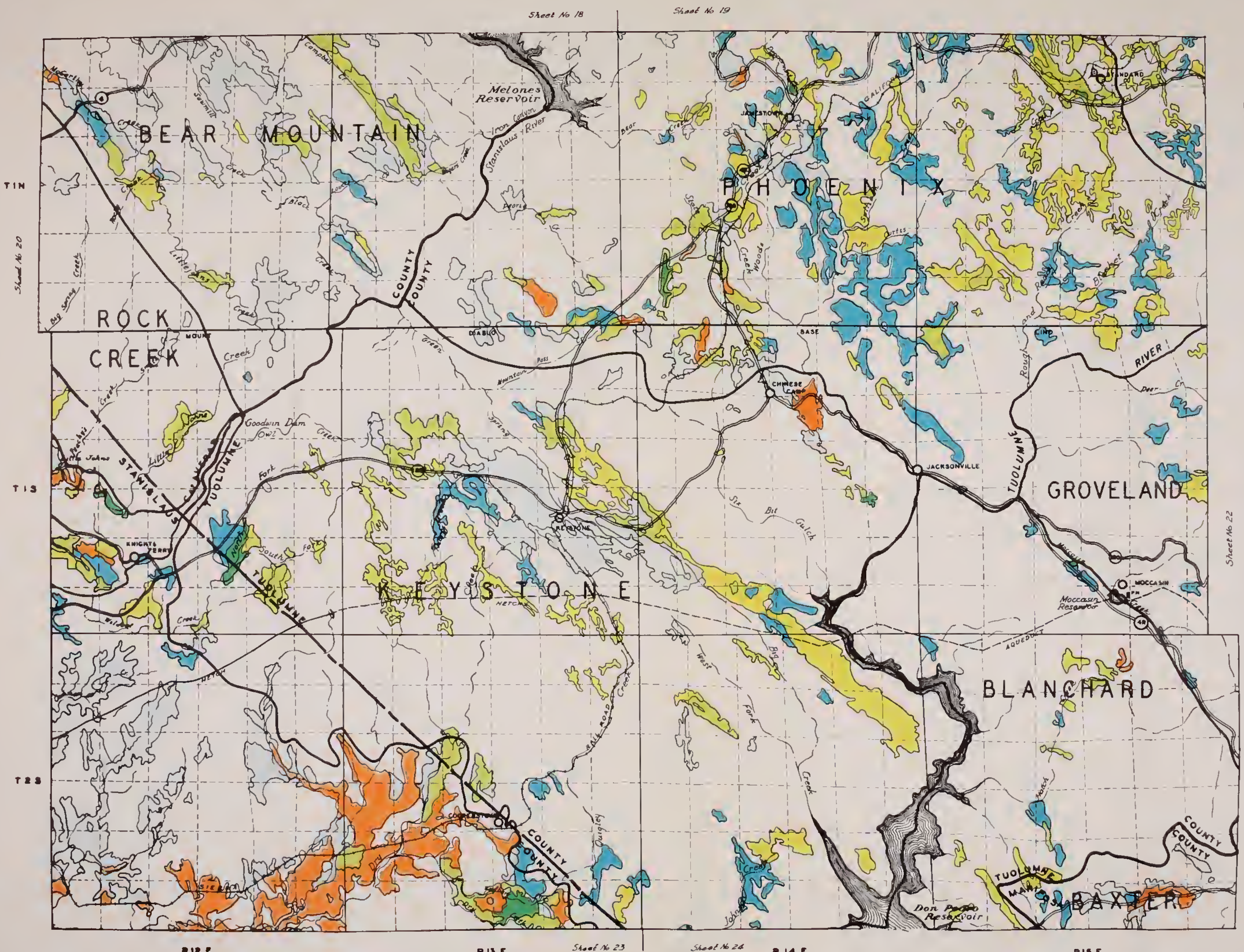
CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 20 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES


COUNTY


COUNTY



LEGEND

- CLASS 1
- CLASS 2
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- CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 21 OF 27 SHEETS

SCALE OF MILES

0 1 2

DIVISION OF WATER RESOURCES

LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 22 OF 27 SHEETS

SCALE OF MILES
1 0 1 2

LEGEND

CLASS 1

CLASS 2

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

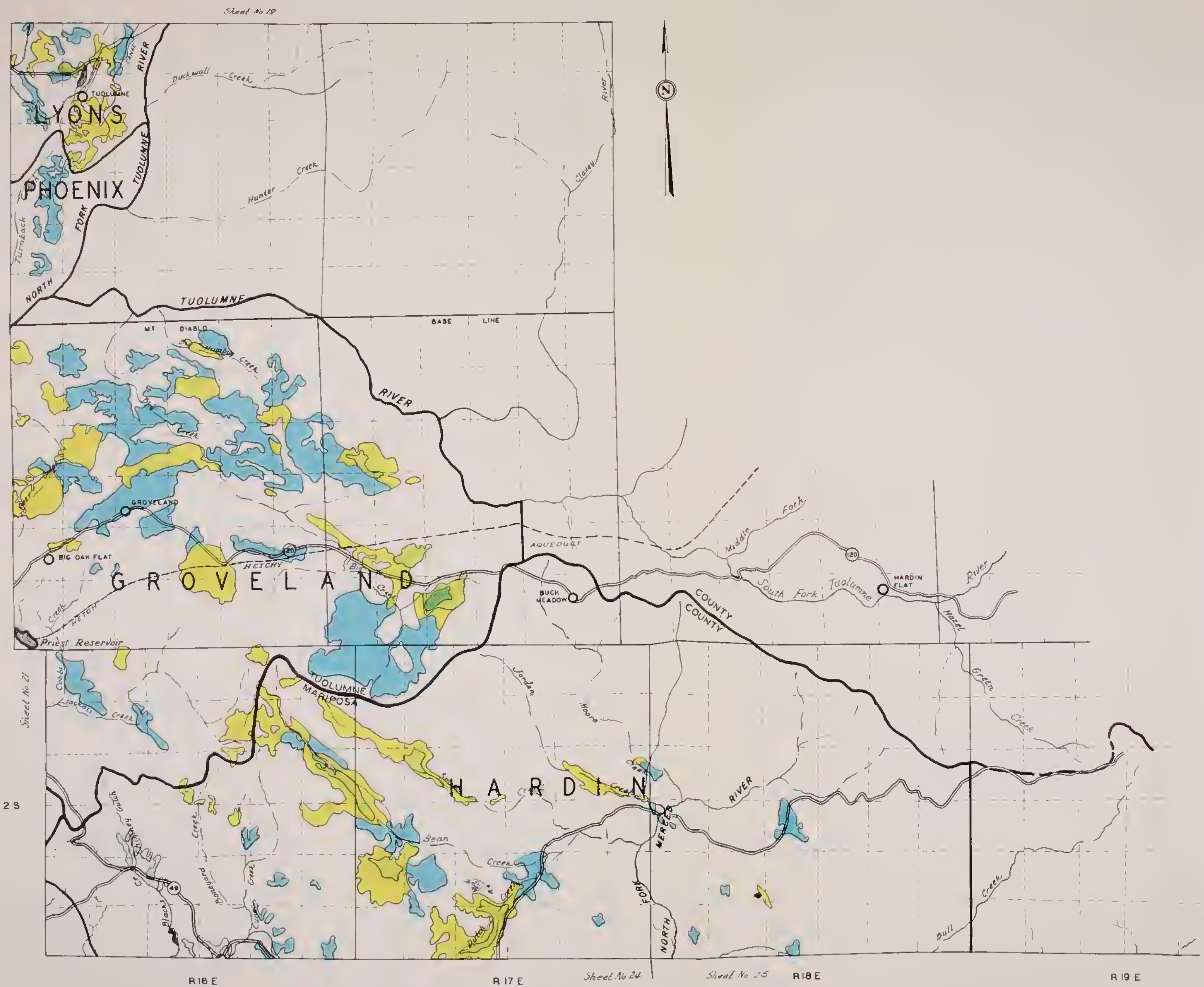
AGRICULTURAL ZONE

1948-1950

SHEET 22 OF 27 SHEETS

SCALE OF MILES

1 0 1 2



LEGEND

- CLASS 1
- CLASS 2
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops. The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity. The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope.

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CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes. Lands of this class are considered unsuitable for irrigation.

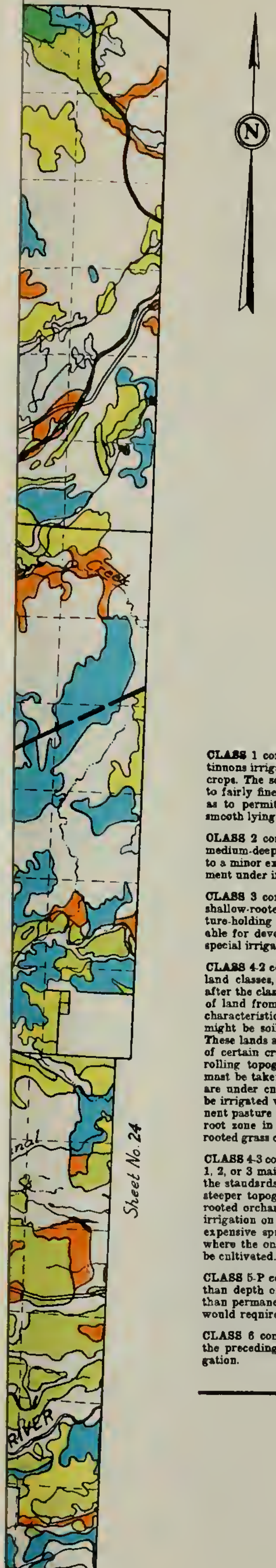
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1946-1950
SHEET 22 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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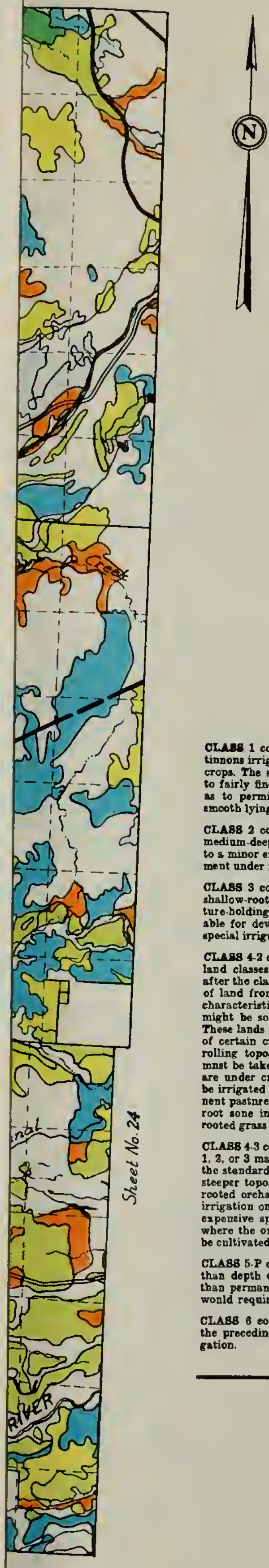
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 23 OF 27 SHEETS

SCALE OF MILES
1 0 1 2



LEGEND

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WATER SERVICE AREA BOUNDARIES

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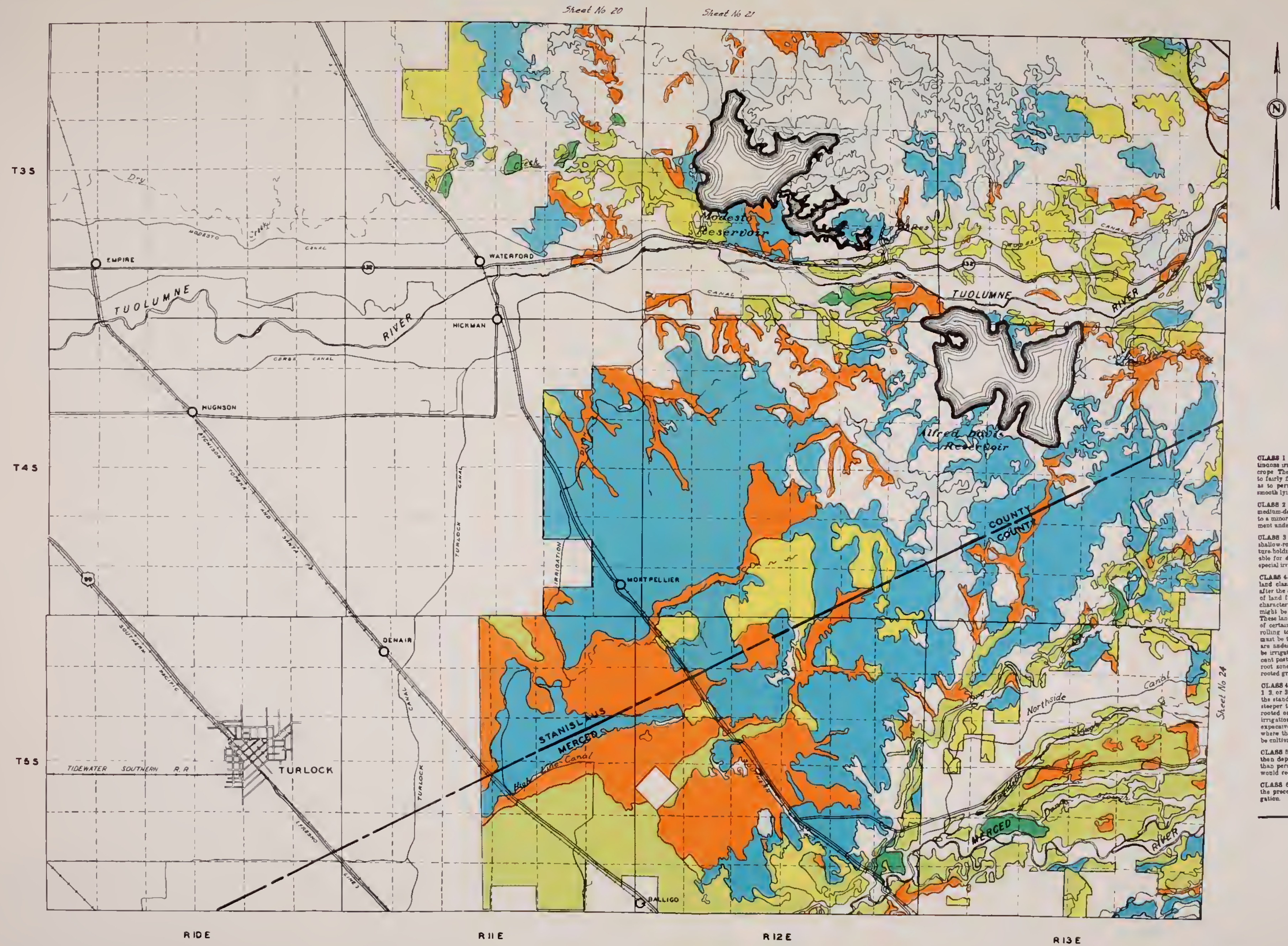

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CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water-holding capacity The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope

CLASS 2 comprises lands that are generally limited to climatically adapted medium-deep rooted crops, due to the restrictive features of the soil depth and to a minor extent on topography or drainage They are well suited for development under irrigation.

CLASS 3 comprises lands that are generally limited to climatically adapted shallow-rooted crops, due to more extreme deficiencies in the soil depth, moisture-holding capacity, topography, or drainage characteristics. They are suitable for development under irrigation, but their shallow nature may require special irrigation practices.

CLASS 4-2 comprises lands which fail to meet the standards for the preceding land classes, especially with regard to topographic conditions The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories. Class 4-2t land might have all the characteristics of Class 1 land except that of topography, or the limiting factor might be soil depth as well as topography as indicated by the letters "st." These lands are suitable through special irrigation practices for the production of certain crops not precluded by climatic conditions Owing to their more rolling topography, they are more susceptible to erosion, and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation Thus, these lands are best suited for crops which can be irrigated with small heads of water, such as orchards, vineyards, or permanent pasture crops In coarse textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow-rooted grass crops.

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1, 2, or 3 mainly on account of topographic conditions Also, they fail to meet the standards of Class 4-2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated.

CLASS 5-P comprises lands which are generally desirable in all respects other than depth of soil, which greatly restricts their adaptability for crops other than permanent pasture However, owing to their shallow depths, these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation.

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

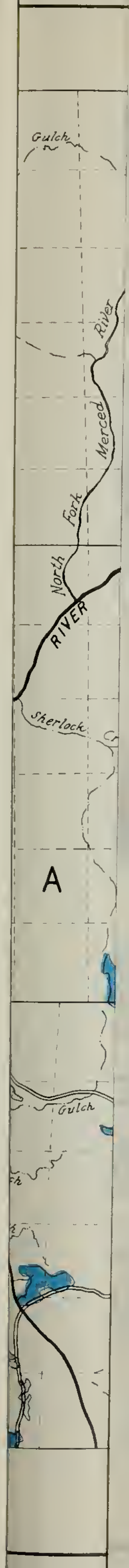
CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 23 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES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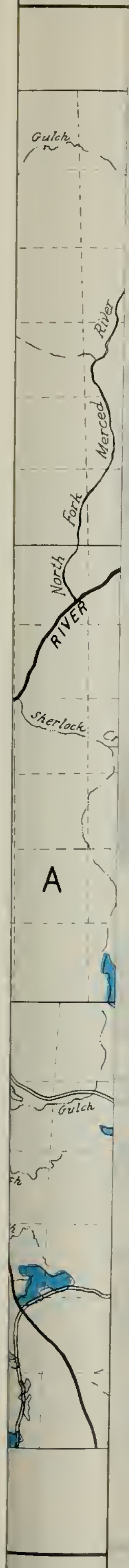
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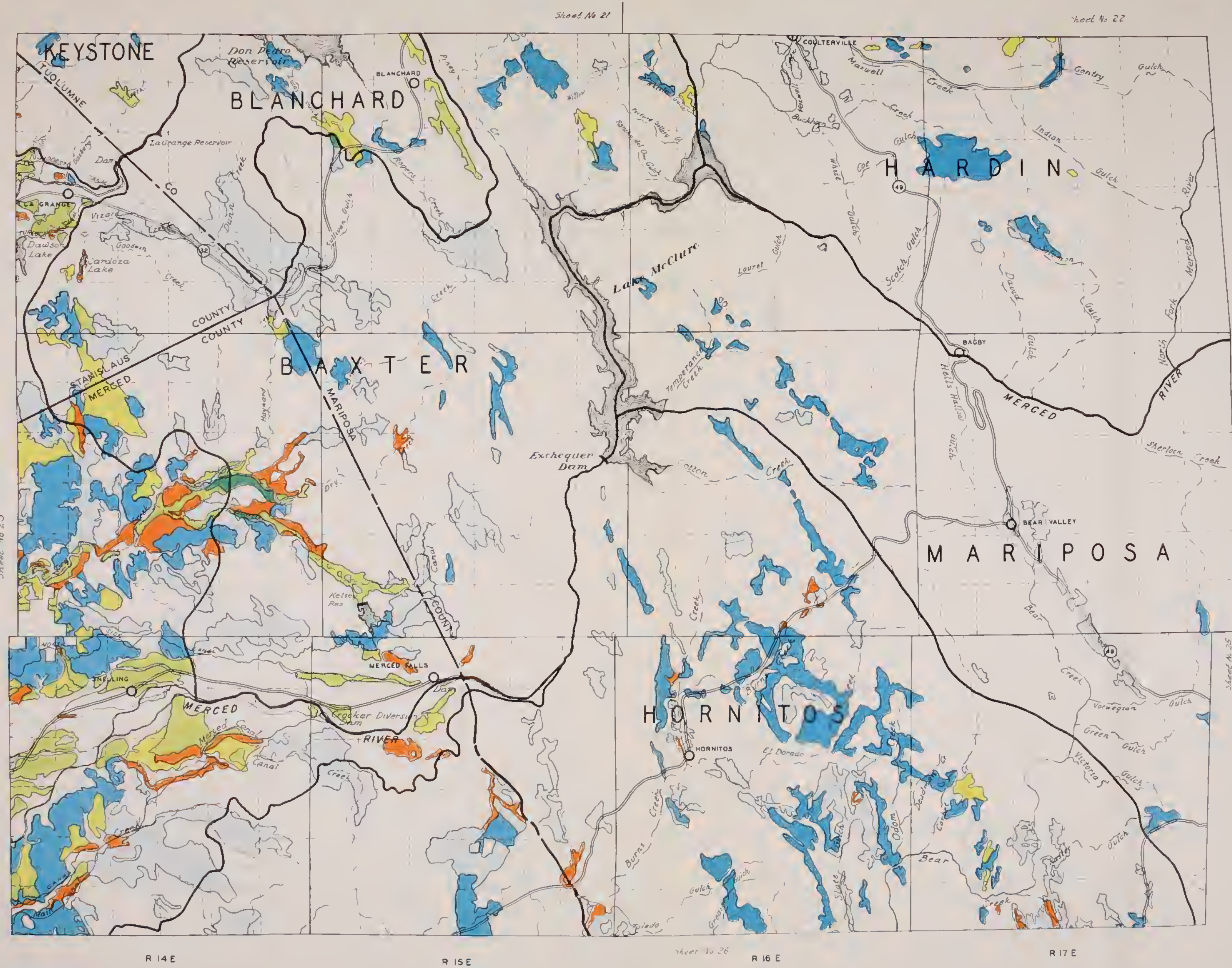

LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage of medium to fairly fine texture and good water holding capacity The structure is such as to permit easy penetration of roots, air and water, and the lands are smooth lying with gentle slope

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CLASS 4 2 comprises lands which fail to meet the standards for the preceding land classes especially with regard to topographic conditions The symbol after the class number indicates the factor which removes the particular parcel of land from the Class 1 or 2 categories Class 4 2t land might have all the characteristics of Class 1 land except that of topography or the limiting factor might be soil depth as well as topography as indicated by the letters st" These lands are suitable through special irrigation practices for the production of certain crops, not precluded by climatic conditions Owing to their more rolling topography they are more susceptible to erosion and greater care must be taken in applying water and maintaining cover crops when the lands are under cultivation Thus these lands are best suited for crops which can be irrigated with small heads of water such as orchards vineyards or permanent pasture crops In coarse textured granitic soils rapid percolation from the root zone in the deeper soils may prohibit the production of very shallow rooted grass crops

CLASS 4-3 comprises lands which would fail to meet the requirements of Classes 1 2 or 3 mainly on account of topographic conditions Also they fail to meet the standards of Class 4 2 lands on account of shallower soil depths as well as steeper topography This class is suitable for the production of such shallow rooted orchards as almonds and olives and for permanent pasture, however irrigation on the steep slopes would require great skill and care or relatively expensive sprinkler system installations On the deeper phases of this class where the only limitation is slope of undulation deeper rooted orchards may be cultivated

CLASS 5 P comprises lands which are generally desirable in all respects other than depth of soil which greatly restricts their adaptability for crops other than permanent pasture However owing to their shallow depths these lands would require more frequent irrigations than preceding classes.

CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS IN THE AGRICULTURAL ZONE

1948-1950

SHEET 24 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES

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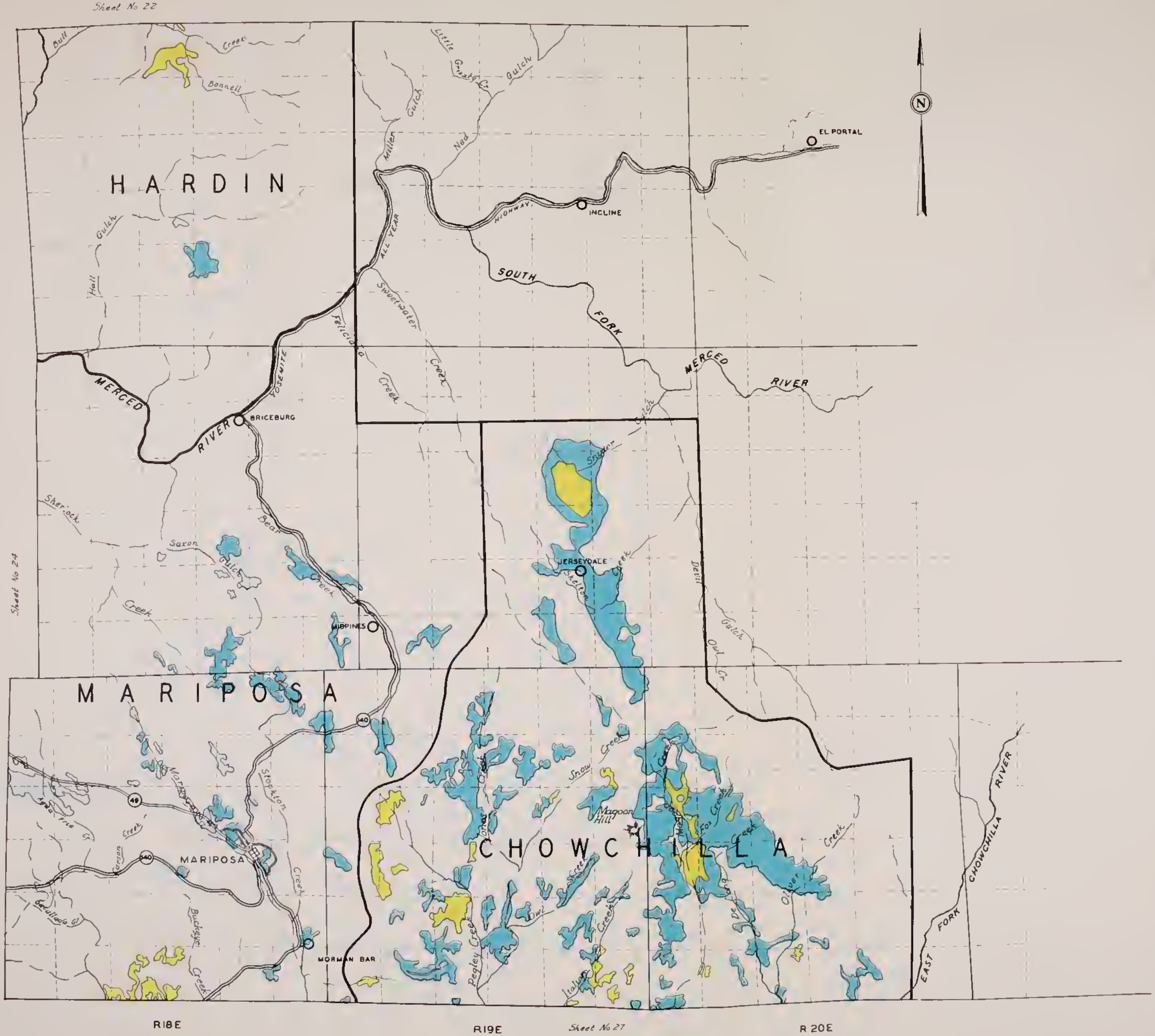

LEGEND

- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

CLASS 1 comprises lands that are highly desirable in every respect for continuous irrigated agriculture and capable of producing all climatically adapted crops The soils are deep with good surface and subsoil drainage, of medium to fairly fine texture, and good water holding capacity The structure is such as to permit easy penetration of roots, air, and water, and the lands are smooth lying with gentle slope

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CLASS 6 comprises land which fails to meet the minimum requirements of the preceding classes Lands of this class are considered unsuitable for irrigation

WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

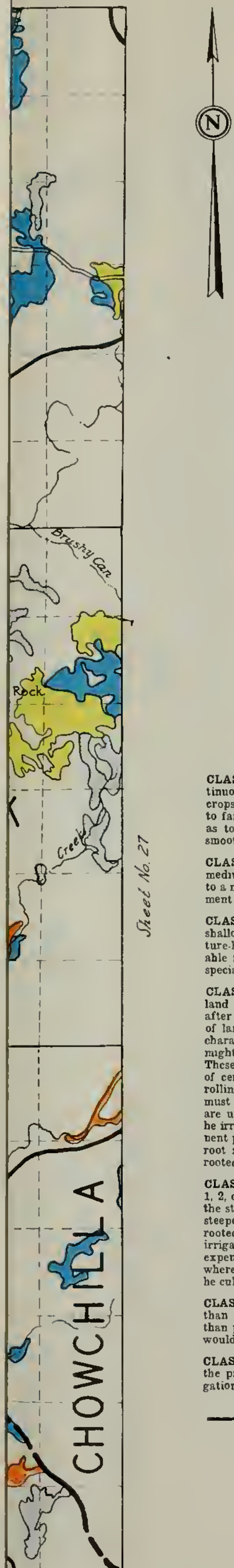
AGRICULTURAL ZONE

1948-1950

SHEET 25 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES



LEGEND

CLASS 1

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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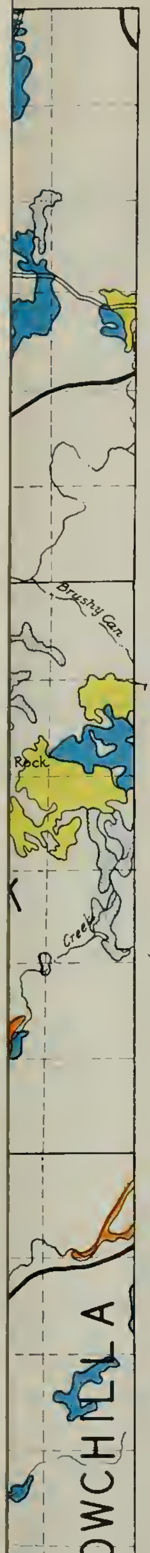
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 26 OF 27 SHEETS

SCALE OF MILES
0 1 2



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4-2
- CLASS 4-3
- CLASS 5-P
- CLASS 6

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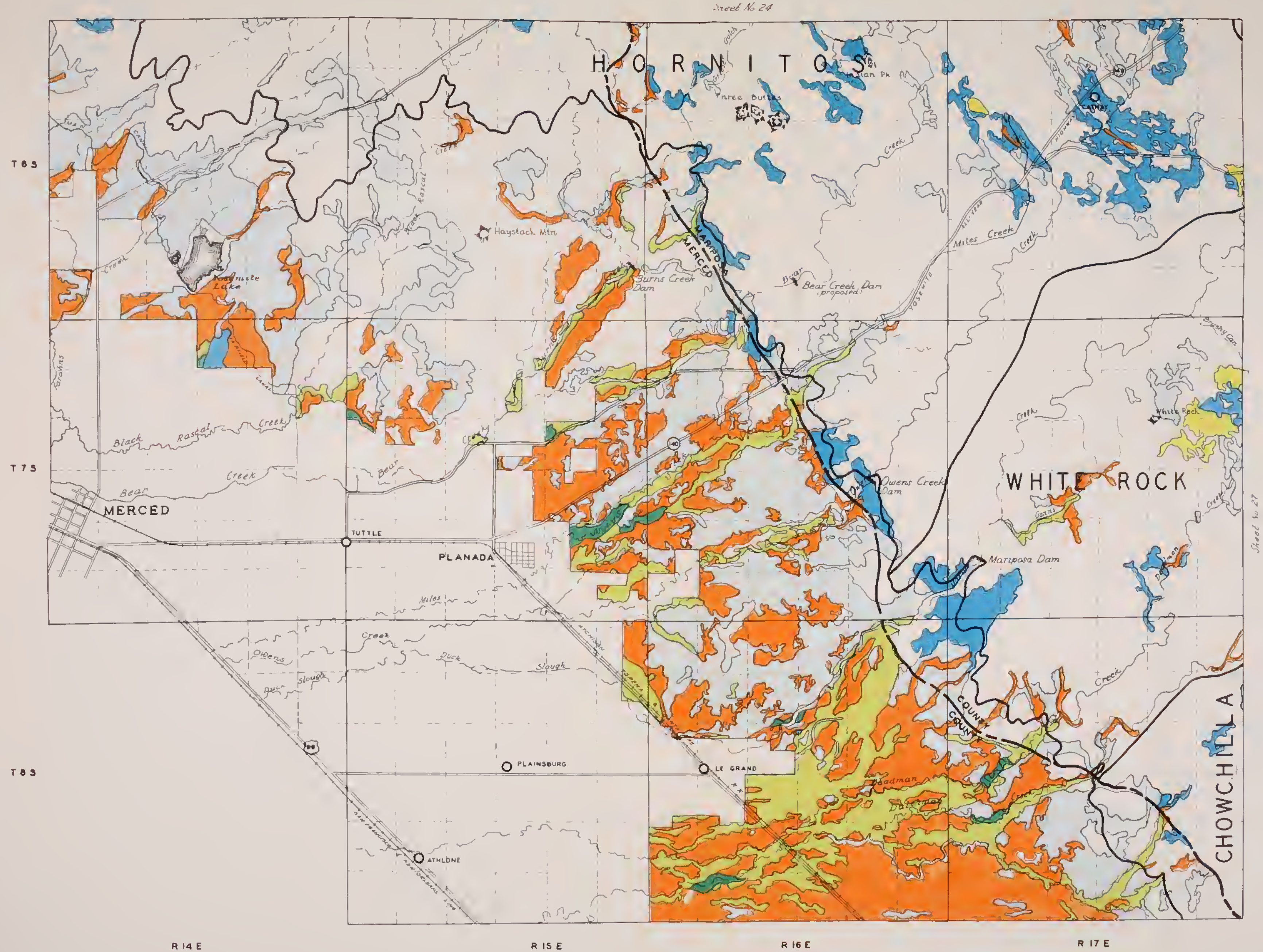
WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 26 OF 27 SHEETS

SCALE OF MILES
0 1 2



LEGEND

- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4 - 2
- CLASS 4 - 3
- CLASS 5 - P
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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950
SHEET 26 OF 27 SHEETS

SCALE OF MILES

DIVISION OF WATER RESOURCES

LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 27 OF 27 SHEETS

SCALE OF MILES

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LEGEND

CLASS 2

CLASS 3

CLASS 4-2

CLASS 4-3

CLASS 5-P

CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS

IN THE

AGRICULTURAL ZONE

1948-1950

SHEET 27 OF 27 SHEETS

SCALE OF MILES

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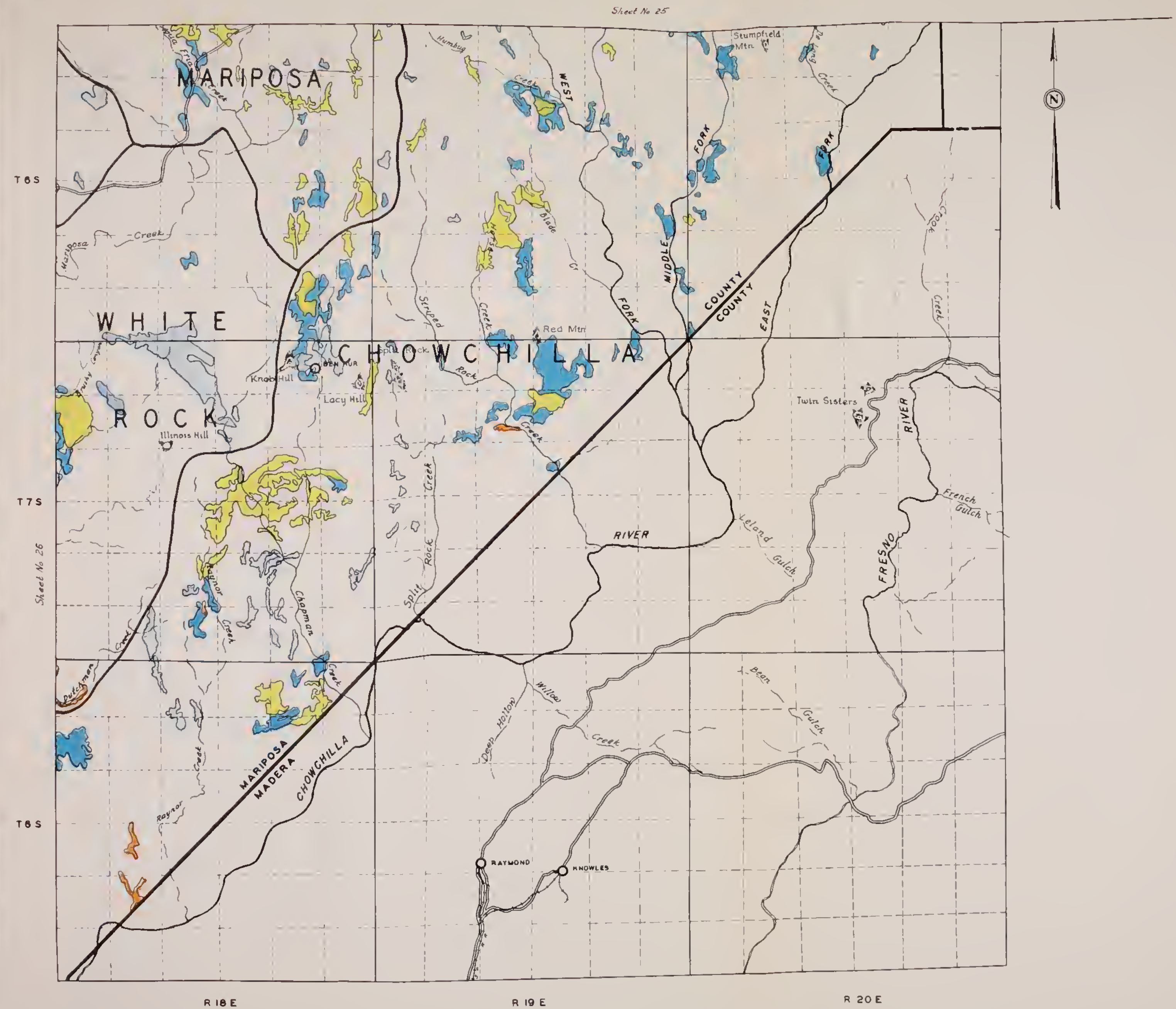

LEGEND

- CLASS 2
- CLASS 3
- CLASS 4-2
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- CLASS 5-P
- CLASS 6

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WATER SERVICE AREA BOUNDARIES

SURVEY OF MOUNTAINOUS AREAS

CLASSIFICATION OF LANDS
IN THE
AGRICULTURAL ZONE
1948-1950

SHEET 27 OF 27 SHEETS

SCALE OF MILES
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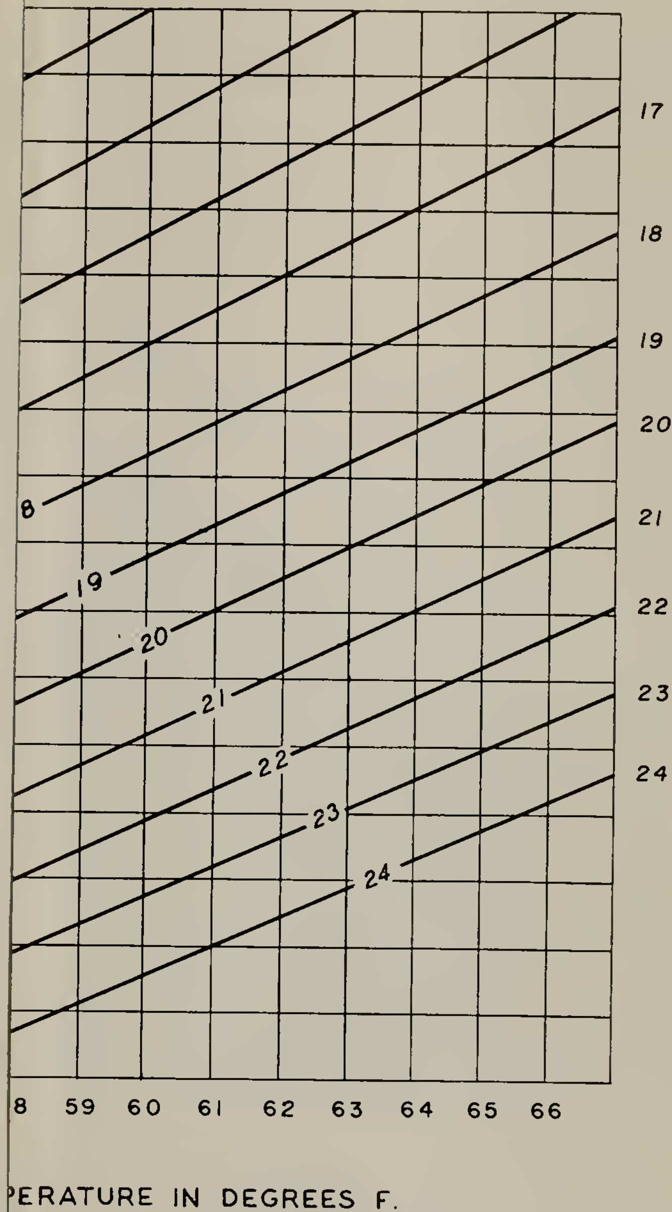
DIVISION OF WATER RESOURCES



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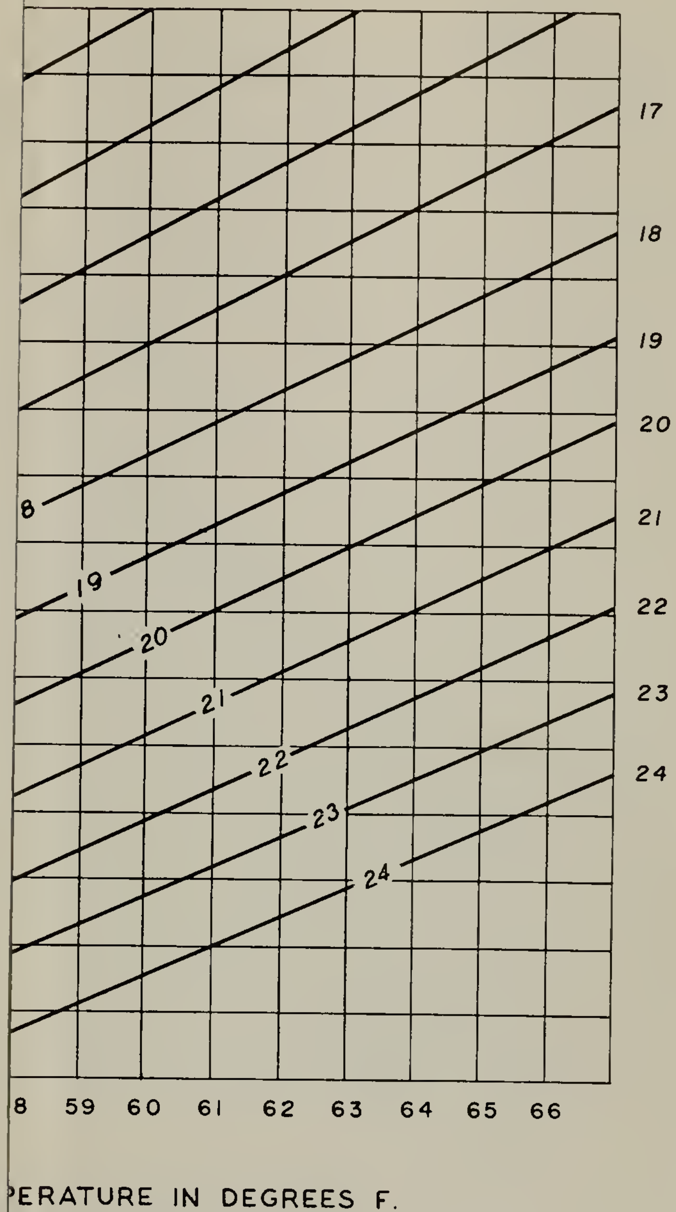
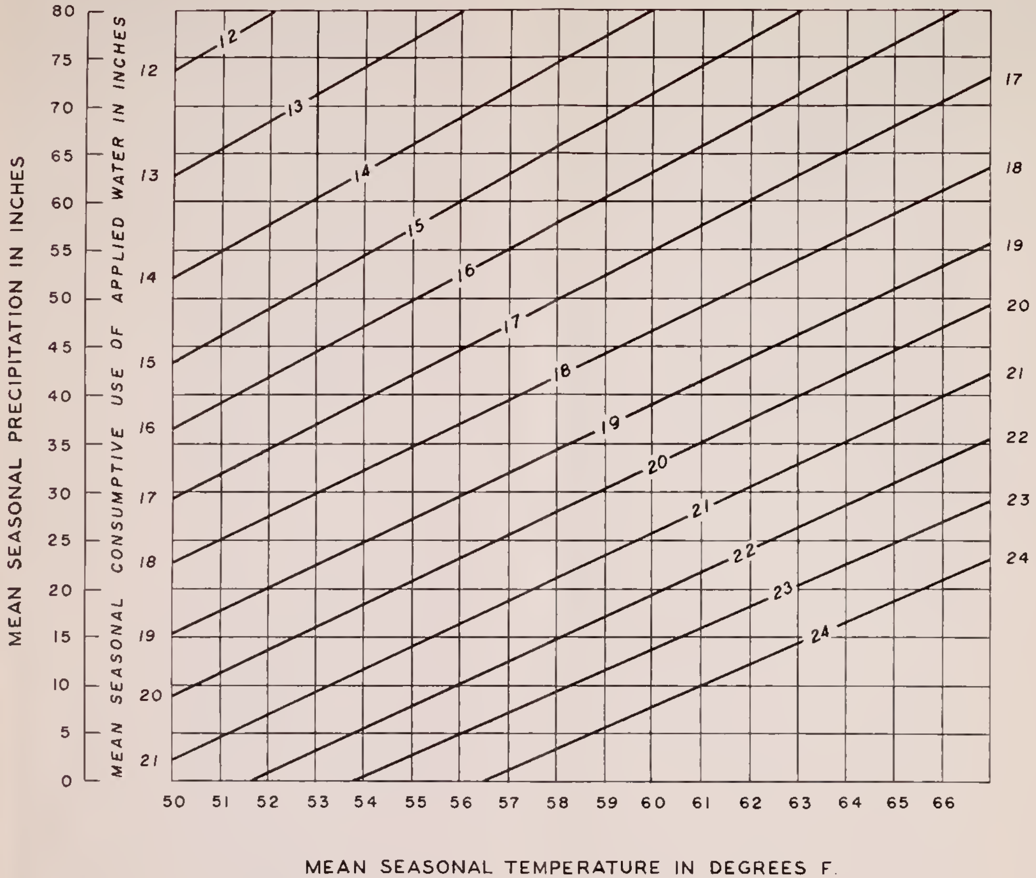
RRIGATION WATER



TWEEN CLIMATE
RRIGATION WATER



GENERAL RELATION BETWEEN CLIMATE
AND
UNIT USE OF APPLIED IRRIGATION WATER

LEGEND

WATER SERVICE AREAS

1 DEER CREEK
2 CHICO
3 MAGALIA
4 BIG BEND
5 BUCKEYE
6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
9 STRAWBERRY
10 BROWNS VALLEY
11 TYLER
12 SMARTVILLE
13 GRASS VALLEY
14 SPAULDING
15 DOTY
16 COLFAX
17 FORESTHILL
18 LOOMIS
19 GEORGETOWN
20 CARSON
21 LATROBE
22 PLACERVILLE
23 YOUNGS
24 AUKUM
25 LAGUNA
26 IONE
27 PLYMOUTH
28 JACKSON
29 VOLCANO
30 WEST POINT
31 ARROYO SECO
32 BEAR CREEK
33 HOGAN
34 MOKELUMNE
35 CALAVERAS
36 STANISLAUS
37 LYONS
38 ROCK CREEK
39 BEAR MOUNTAIN
40 PHOENIX
41 KEYSTONE
42 BLANCHARD
43 GROVELAND
44 HARDIN
45 BAXTER
46 HORNITOS
47 MARIPOSA
48 WHITE ROCK
49 CHOWCHILLA

BOUNDARY OF INVESTIGATED AREA
WATER SERVICE AREA BOUNDARIES
EASTERN BOUNDARY OF AGRICULTURAL ZONE AND WESTERN BOUNDARY OF NATIONAL FOREST ZONE

EXISTING WORKS

RESERVOIR
POWER HOUSE
CONDUIT
TUNNEL

PROPOSED WORKS

RESERVOIR
POWER HOUSE
CONDUIT
TUNNEL

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

SURVEY OF MOUNTAINOUS AREAS

PLANS FOR WATER DEVELOPMENT
1954

SCALE OF MILES
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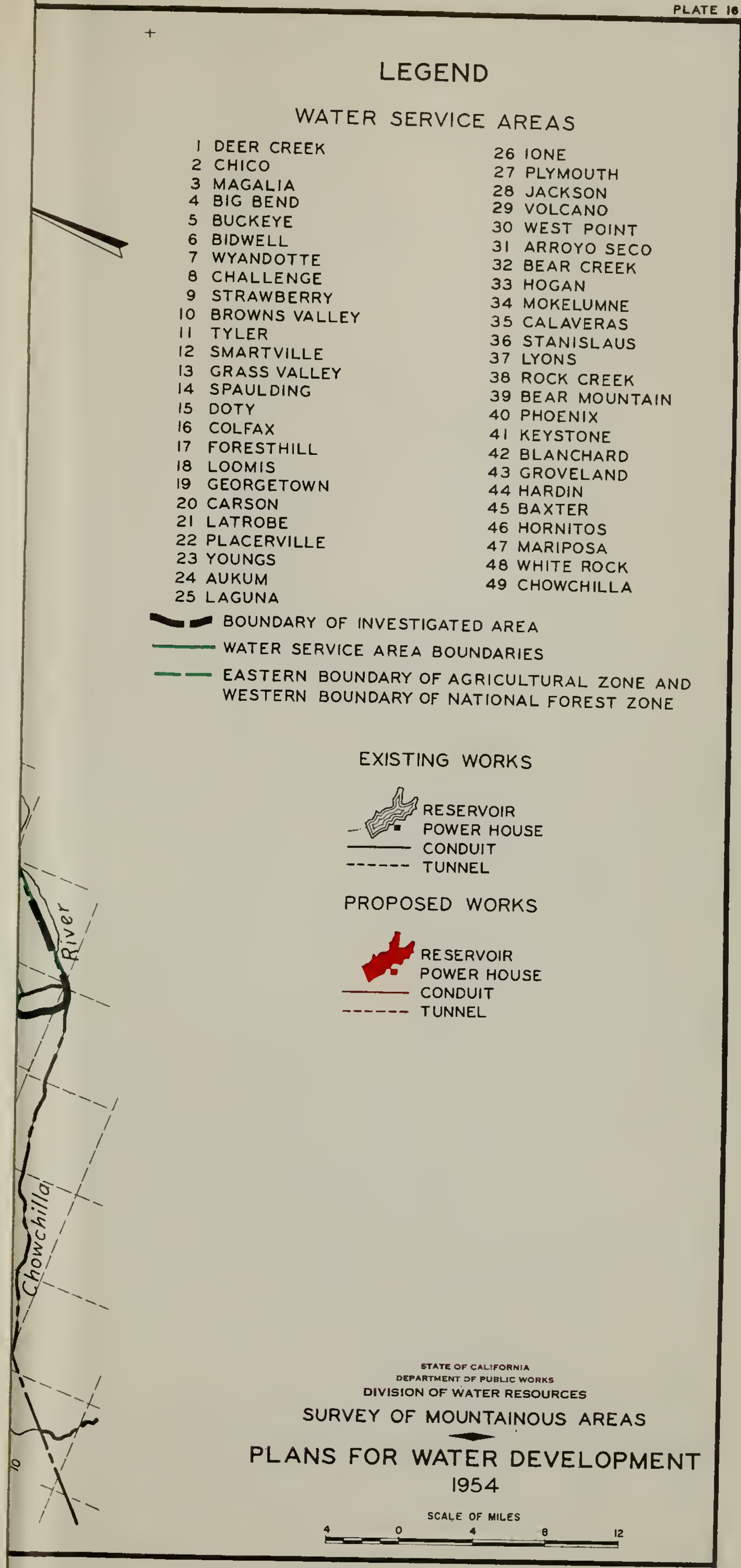
LEGEND
WATER SERVICE AREAS
1 DEER CREEK
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3 MAGALIA
4 BIG BEND
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CONDUIT
TUNNEL
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RESERVOIR
POWER HOUSE
CONDUIT
TUNNEL
River
Chowchilla
10
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
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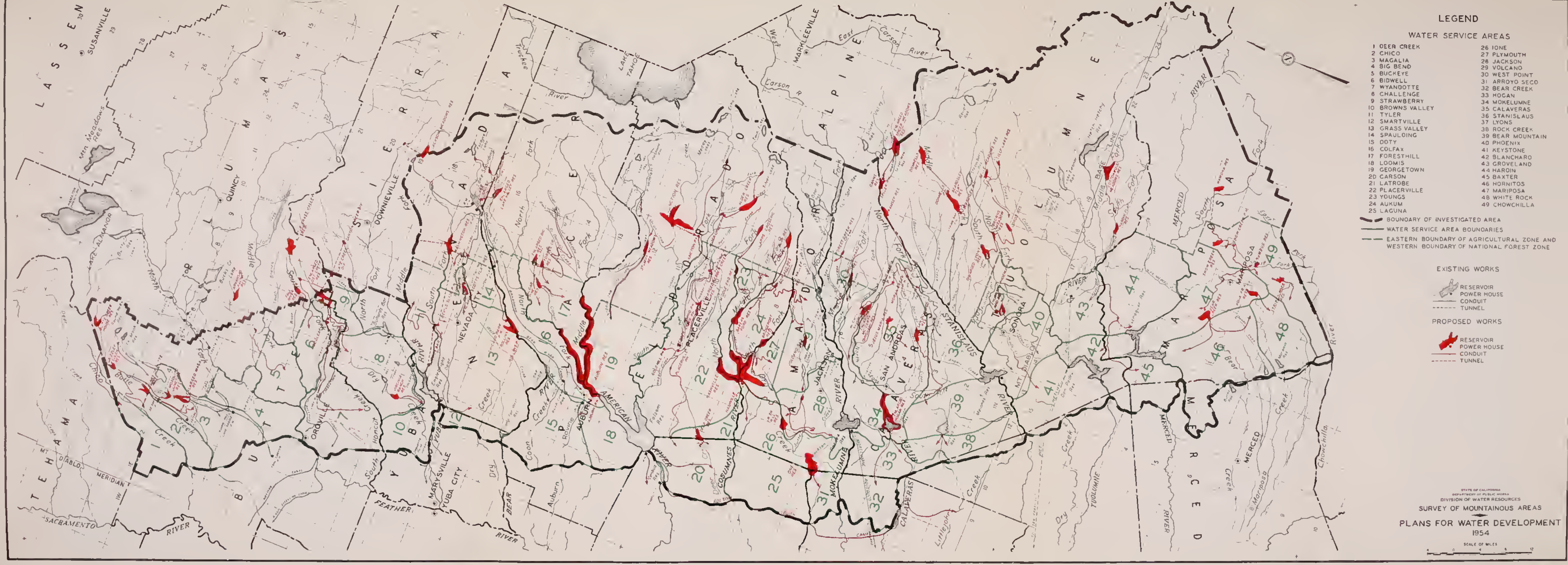
1954
SCALE OF MILES
4 0 4 8 12

PLATE 16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6 BIDWELL
7 WYANDOTTE
8 CHALLENGE
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CALAVERAS
TUOLUMNE
MARIPOSA
MERCED
TEHAMA
BUTTE
YUBA
OROVILLE
MARYSVILLE
YUBA CITY
AUBURN
PLACERVILLE
JACKSON
SAN ANDREAS
SONORA
MARKLEEVILLE
LAKE TAHOE
SACRAMENTO
FEATHER
AMERICAN
MOKELUMNE
COSUMNES
STANISLAUS
TUOLUMNE
MT. DIABLO MERIDIAN

APPENDIX A

DESCRIPTION OF SERVICE AREAS

4—99504

APPENDIX A

DESCRIPTION OF SERVICE AREAS

4—99504

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DESCRIPTION OF SERVICE AREAS

DESCRIPTION OF SERVICE AREAS

AMADOR COUNTY

Ione Service Area

Location and Physical Features. The Ione Service Area comprises that part of Amador County lying below a proposed foothill conduit from Nashville Reservoir site on the Cosumnes River. A tentative location of the conduit runs from Nashville dam site south to the Mokelumne River, passing west of Plymouth and slightly east of Ione. The area is bounded on the west by Sacramento and San Joaquin Counties, on the north by the Consumnes River, and on the south by the Mokelumne River.

Mean seasonal depth of precipitation varies from 18 to 28 inches. Elevations range from 200 to 1,000 feet above sea level. Most of the irrigable lands are below the 700-foot contour.

Soils on the flat alluvial plains of Jackson and Ione Valleys are largely of the Goldridge series-group, derived principally from the sediments of the Ione formation and to a lesser extent from the Valley Springs and Mehrten formations. Considerable areas of relatively shallow recent alluvium are found along the channels of Dry and Jackson Creeks. Parallel ranges of gently to steeply rolling typical foothill topography, containing soils of the Auburn, Hugo, and Montara series-groups, traverse the eastern part of the service area.

The gross land area is about 79,000 acres, of which about 48 per cent has been classified as irrigable. More than one-third of the irrigable land is rated as Class 3 or better. The lands are well concentrated in and around Jackson and Ione Valleys. The service area contains 56 per cent of the irrigable land in Amador County, including nearly all of the Class 1 land, 80 per cent of the Class 2 land, and 83 per cent of the Class 3 land. The over-all suitability of the irrigable land in the Ione Service Area is the highest in the entire Mother Lode Region.

Present Development. About one-third of the 9,000 inhabitants of Amador County live in the Ione Service Area. The principal town and business center is Ione, with about 1,000 population.

The area is served by a branch of the Southern Pacific Railroad from Galt to Ione, and by a network of secondary state and county roads.

Although the area contains a majority of the irrigated and cultivated lands in Amador County, only 830 acres of the gross irrigable area of 38,000 acres were under irrigation in 1948. About 4,640 acres were dry-farmed, almost exclusively to grain hay. The total cultivated acreage is about 14 per cent of the gross irrigable area. Other lands are largely devoted to dry pasture.

Irrigated lands are served by small individual water supply developments along Dry Creek, and from the Cosumnes River by means of the Plymouth Ditch. The latter is dependent on the unregulated flow of the river and the supply is not dependable. Domestic water for the town of Ione is supplied from the Mokelumne River by means of the Amador Canal of the Pacific Gas and Electric Company.

Jackson Service Area

Location and Physical Features. This service area is located in west central Amador County between Dry Creek and the Mokelumne River. The area extends west from the existing Amador Canal to the tentative location of a proposed canal from Nashville Reservoir on the Cosumnes River. This canal route follows approximately the 400-foot contour and passes just east of Ione.

Mean seasonal depth of precipitation varies from 19 to 31 inches. Elevations range from 400 to 1,800 feet above sea level. Most of the irrigable lands are located in the vicinity of State Highway 49, between 1,000 and 1,500 feet in elevation. Topography is gently to steeply rolling throughout.

Soils in the western part of the service area along the strike of the Mother Lode are of the Montara, Auburn, and Hugo series-groups, with small local granitic intrusions on which Holland soils have been developed. East of the town of Jackson the soils are almost exclusively of the Hugo series-group developed on the Calaveras formation.

The gross land area is about 80,000 acres, of which 13 per cent has been classified as irrigable. The lands are generally inferior in quality, with some 75 per cent being in Classes 4(3) or 5(P). The irrigable lands are generally quite scattered throughout the area, except in the extreme western portion adjacent to Jackson Valley.

Present Development. About one-half of the 9,000 inhabitants of Amador County reside in the Jackson Service Area. Principal towns and business centers are Jackson, the county seat, with a population of about 2,000, and Sutter Creek, with a population of 1,150. Amador City and Drytown are other small centers of population.

The area is served by a branch of the Southern Pacific Railroad from Galt through Ione to Martell, and by a network of secondary state and county roads.

Agricultural lands in the Jackson Service Area are used principally for grazing. In 1948 the total cultivated area was only 760 acres, about seven per cent of the gross irrigable area of 10,600 acres. No lands were irrigated. The crops grown were grain and hay and dry-farmed orchards and vineyards.

Water from the North Fork of the Mokelumne River is supplied to the service area by the Amador Canal of the Pacific Gas and Electric Company. By agreement with the East Bay Municipal Utility District, the annual diversion through the Amador Canal is limited to 15,000 acre-feet, at a maximum rate of 30 second-feet. In 1950 the gross diversion was 6,970 acre-feet, and a substantial portion of that diversion was lost in conveyance through the unlined canal between Lake Tabeaud and the service area. The principal use of water from the Amador Canal is for domestic service in Jackson, Sutter Creek, Amador City, and Ione.

Plymouth Service Area

Location and Physical Features. The Plymouth Service Area is located in the north central part of Amador County, between the South Fork of the Cosumnes River and Dry Creek. The area extends from the headwaters of Dry Creek to the location of a possible conduit line from the proposed Nashville Reservoir on the Cosumnes River southerly to Dry Creek.

Mean seasonal depth of precipitation varies from 22 to 35 inches. Elevations range from 1,000 to 3,000 feet above sea level. The majority of the irrigable lands are below the 2,000-foot contour, and the largest single body of arable land is situated in Shenandoah Valley at an elevation of about 1,500 feet.

Soils in the extreme western part of the area along the Mother Lode are of the Auburn and Hugo series-groups. In Shenandoah Valley and the surrounding area there is a zone of excellent Holland soil. The remainder of the service area east of Shenandoah Valley is composed of soils of the Hugo series-group, with a limited capping of Aiken soils on the ridge tops in the higher elevations.

In Shenandoah Valley, and in the area around Plymouth, where most of the irrigable lands are located, the terrain is characterized by moderate slopes. Topography in the remainder of the service area is generally rolling to hilly, with steep slopes along the principal streams.

The gross land area is about 42,000 acres, of which 23 per cent is considered to be irrigable land. About two-thirds of the irrigable land is located in Shenandoah Valley northeast of Plymouth and Fiddletown. Agricultural lands in that area are excellent. The remainder of the irrigable lands of the service area is widely scattered in small parcels.

Present Development. Plymouth, a community with about 400 inhabitants, is the only important settlement in the service area. Transportation requirements are met by secondary state and county roads. The nearest railroad connection is at the town of Ione, about 12 miles southwest of Plymouth.

Agricultural development in the Plymouth Service Area is considerable, including most of the vineyards and about one-half of the orchards in Amador County. In 1948, only 40 acres of the gross irrigable area of 9,860 acres were under irrigation. The total cultivated area was 1,750 acres.

The only existing water supply of significance is furnished through the Plymouth Ditch, diverting from the Middle and South Forks of the Cosumnes River, and serving for domestic use in the town of Plymouth and for a small amount of irrigation in that vicinity. The ditch is dependent upon the unregulated runoff of the Cosumnes River and therefore does not produce a dependable water supply.

Volcano Service Area

Location and Physical Features. This service area is located in central Amador County, between Dry Creek and the North Fork of the Mokelumne River, extending from the existing Amador Canal to the east boundary of Range 13 East, M. D. B. & M.

Mean seasonal depth of precipitation varies from 23 to 50 inches. Elevations range from 1,500 to 4,000 feet above sea level, but most of the irrigable land is located below the 3,000-foot contour.

Soils in the area are of the Hugo series-group, except where ridge tops are capped with more recent volcanic material on which Aiken soils have been developed. The latter form the principal lands suitable for agricultural development.

The topography is generally hilly to mountainous, but slopes on the broad ridges between local streams are fairly gentle.

The gross land area is about 76,000 acres, about 12 per cent of which is classified as irrigable land. The irrigable lands are of fairly good quality, being about evenly divided between Classes 4(2) and 4(3). The irrigable lands occur in rather large parcels atop the ridges between the deeply intrenched local streams.

Present Development. The Volcano Service Area is sparsely populated. The largest settlement is the town of Volcano, with about 300 inhabitants. Access to the area is provided by a network of secondary state and county roads.

In 1948, the total cultivated area was 340 acres. This included 30 acres under irrigation, which represented less than four per cent of the gross irrigable area of 9,240 acres. Principal use of the land is for stock grazing purposes.

The service area has no dependable water supplies for irrigation purposes at present.

BUTTE COUNTY

Bidwell Service Area

Location and Physical Features. The Bidwell Service Area is located in Butte County between the South and Middle Forks of the Feather River, and extends to a point about five miles east of Feather Falls.

Mean seasonal depth of precipitation varies from 40 to 73 inches. Elevations range from 500 to 4,000 feet above sea level, with the bulk of the irrigable land situated above the 3,000-foot contour.

Soils of the Holland series-group cover most of the service area. Limited zones of Aiken and Montara soils occur in the extreme northeast portion.

Along the canyons of the South and Middle Forks of the Feather River the terrain is rugged and steep, but atop the ridge between the two streams, where the irrigable land is located, the slopes are generally moderate.

The gross land area is about 38,000 acres, less than 14 per cent of which is classified as irrigable land. About 70 per cent of the irrigable land is rated Class 4(3), and virtually all of the remainder is Class 4(2). Most of the irrigable land is fairly well concentrated in the vicinity of Feather Falls and Lumpkin.

Present Development. Feather Falls, a logging town of some 125 inhabitants is the largest community in the sparsely settled area.

Access to the Bidwell Service Area is provided by secondary county roads. A logging railroad traverses the ridge between the South and Middle Forks of the Feather River, and connects with the Western Pacific Railroad near Bidwell Bar.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 5,170 acres, almost none of which was cultivated. A few hundred acres were used for dry pasture.

Two small diversions from local creeks provide water for logging operations, and springs and wells furnish domestic water supplies.

Big Bend Service Area

Location and Physical Features. This service area is located in Butte County between the North Fork of the Feather River and the Miocene Canal of the Pacific Gas and Electric Company, and extends from Concow Reservoir on the north to the vicinity of Oroville on the south. The Miocene Canal diverts from the West Branch of the Feather River, and runs generally south to the vicinity of Oroville.

Mean seasonal depth of precipitation varies from 26 to 80 inches. Elevations range from 400 to 3,000 feet above sea level, with most of the irrigable land situated between the 1,000 and 2,000-foot levels.

Most of the service area is covered by soils of the Auburn series-group. Small zones of Holland and Montara soils occur in the extreme northern part of the area, and alluvial soils occur in the southwest portion in a zone of limited extent. A substantial zone of soils of the Hugo-Auburn complex is located in the central part of the area.

The Big Bend Service Area is cut by numerous creeks, and the terrain is generally choppy and hilly throughout, with only small local zones where slopes are moderate.

The gross land area is about 57,000 acres, less than eight per cent of which is classified as irrigable land. The quality of the irrigable lands is generally poor, more than 76 per cent of the total being rated Class 4(3) or 5(P). For the most part, the irrigable lands occur in small, widely dispersed parcels.

Present Development. With the exception of Cherokee, a community of 250 inhabitants, the small population of the service area is completely rural in character. The area is served by secondary state and county roads.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 4,100 acres, less than 200 acres of which were cultivated, including one small parcel of irrigated pasture. The only substantial present use of agricultural lands is for dry pasture.

The Big Bend Service Area has no significant developed water supply at present, although a canal from Concow Reservoir crosses the upper part of the service area enroute to the Miocene Canal and the Lime Saddle Power Plant. Concow Reservoir is owned by the Thermalito and Table Mountain Irrigation Districts.

Buckeye Service Area

Location and Physical Features. The Buckeye Service Area is located in Butte County between the North and Middle Forks of the Feather River, extending northeast from the junction of the forks to the vicinity of the Brush Creek Ranger Station.

Mean seasonal depth of precipitation varies from 33 to 70 inches. Elevations range from 500 to 4,000 feet above sea level, with most of the irrigable land situated above the 2,000-foot contour.

Soils of the Holland series-group cover virtually all of the eastern half of the area. Small zones of Montara or Aiken soils occur. The western part of the service area is covered exclusively by soils of the Auburn series-group. The majority of the irrigable lands have soils of the Holland series-group.

The terrain varies from steep and rugged along the canyons of the North and Middle Forks of the Feather River, to rolling and hilly on top of the ridge between the two streams. Timber cover is fairly heavy throughout.

The gross land area is about 51,000 acres, about 10 per cent of which is classified as irrigable land. About 57 per cent of the irrigable land is rated Class 4(2), and virtually all the remainder is rated Class 4(3).

Two single bodies of land account for more than half the total irrigable area. One of these parcels is located in the vicinity of the Brush Creek Ranger Station, and the other is situated along the left bank of Berry Creek above Lake Madrone. Other agricultural lands are generally scattered in fairly small parcels.

Present Development. The small population of the Buckeye Service Area is completely rural in character, with no towns of more than a few score inhabitants.

The area is served by the state highway from Oroville to Quincy, by secondary county roads, and by the main line of the Western Pacific Railroad, which follows the North Fork of the Feather River.

The land classification and land use survey conducted in 1948 listed a gross irrigable area of 5,200 acres, only about six per cent of which was under cultivation. Most of the cultivated land was devoted to irrigated pasture.

Present water supplies are obtained by individual developments on local creeks. Lake Madrone on Berry Creek has a storage capacity of 500 acre-feet.

Chico Service Area

Location and Physical Features. This service area is located in northwestern Butte County between Big Chico Creek and Butte Creek, and extends from the vicinity of Chico to a point about two miles north of Forest Ranch and De Sabla.

Mean seasonal depth of precipitation varies from 28 to 59 inches. Elevations range from 400 to 3,000 feet above sea level, with the majority of the irrigable lands situated above the 2,000-foot contour.

In the upper part of the service area, where most of the irrigable lands are located, soils of the Aiken series-group predominate. Soils of the Auburn series-group cover most of the lower part of the area. Long narrow zones of Hugo soils extend from the northern limit of the area almost to the southern boundary.

Topographically, the Chico Service Area may be described as a system of three well-intrenched parallel streams separated by narrow ridges. In the upper part of the area the canyons of Big Chico Creek and Butte Creek are more than 1,000 feet deep. Little Chico Creek, located between the other two streams, is less deeply intrenched.

The gross land area is about 38,000 acres, less than 10 per cent of which is classified as irrigable. The over-all quality of the agricultural land is fairly good, more than 71 per cent of the gross irrigable area being rated Class 4(2) or better. The bulk of the irrigable land occurs in two large parcels located in the vicinity of Forest Ranch.

Present Development. The small population of the Chico Service Area is completely rural in character. The area is serviced by a secondary state highway and by county roads.

The land classification and land use survey conducted in 1948 listed a gross irrigable area of 3,700 acres, less than 300 acres of which were cultivated, including a few acres of irrigated orchard. Orchards and grain hay were the principal dry-farmed crops, and some land was used for dry pasture.

Deer Creek Service Area

Location and Physical Features. The Deer Creek Service Area is located in northwest Butte County between Big Chico Creek and the Tehama county line, and extends from the vicinity of Chico northeast to Anderson Mill.

Mean seasonal depth of percipitation varies from 27 to 61 inches. Elevations range from 400 to 3,500 feet above sea level, with the majority of the irrigable land situated above the 2,000-foot contour.

Soils of the Aiken series-group cover the upper portion of the service area where most of the irrigable lands are located. In the southern portion, soils of the Auburn series-group predominate.

The area is cut by numerous creeks, and the terrain is generally choppy and hilly throughout, although slopes are moderate atop some of the ridges where the bulk of the irrigable land is situated.

The gross land area is about 48,000 acres, about 10 per cent of which is classified as irrigable. The over-all quality of the agricultural land is fairly good, more than 80 per cent of the gross irrigable area being rated Class 4(2). Almost all of the irrigable land is concentrated in the Keefer Ridge district between Anderson Mill and Cohasset.

Present Development. The Deer Creek Service Area is a thinly populated rural district, with no towns of more than a few score inhabitants. The resort of Richardson Springs, near the lower boundary of the area, has a population of about 100. Access to the area is provided by secondary county roads.

The land classification and land use survey conducted in 1948 listed a gross irrigable area of 4,800 acres, less than 200 acres of which were cultivated, principally in deciduous orchards. No land was irrigated and only a few hundred acres were used for dry pasture.

Magalia Service Area

Location and Physical Features. This service area is located in north central Butte County between Butte Creek on the west and the West Branch of the Feather River and the Miocene Canal on the east, and extends from the vicinity of Durham north to Stirling City.

Mean seasonal depth of precipitation varies from 28 to 72 inches. Elevations range from 400 to 3,000 feet above sea level, with the majority of the irrigable land situated above the 1,500-foot contour.

Soils of the Hugo series-group predominate at the highest elevations, and occur in narrow zones of limited extent at the intermediate elevations where soils of the Aiken series-group are the predominant type. Virtually all of the soils in the lower portion of the area are of the Auburn series-group.

The lower part of the Magalia Service Area is cut by numerous creeks into a pattern of fairly deep canyons and narrow ridges. Above the 1,500-foot level, between the canyons of Butte Creek and West Branch of the Feather River, there is a broad ridge extending to the upper limits of the service area. In the vicinity of Paradise the ridge is about five miles wide, and slopes are moderate. As elevation increases, the ridge becomes narrower and slopes become somewhat steeper. The great majority of the irrigable land in the service area is located on the Paradise Ridge.

The gross land area is about 85,000 acres, almost 23 per cent of which is classified as irrigable land. The over-all quality of the agricultural land is fairly good, more than 70 per cent of the gross irrigable area being rated Class 4(2) or better. In the area north of the Paradise Irrigation District the irrigable lands are predominantly Class 4(2), and are well concentrated. Inside the Paradise Irrigation District the irrigable land is concentrated in one large body, consisting principally of Class 4(2) and 4(3) lands, with the former type predominating. Most of the Class 2, 3, and 5(P) lands are located at the lower elevations south of the irrigation district boundary, and are somewhat scattered in occurrence.

Present Development. The Magalia Service Area is one of the most populous in the entire Mother Lode Region. Most of the population is concentrated in the Paradise Irrigation District in the central part of the area. There is no incorporated town in the district, yet about 6,000 people live within the district boundaries. The area is served by a branch of the Southern Pacific Railroad, and by secondary state and county roads.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 19,400 acres, of which approximately 3,000 acres were cultivated, including 1,900 acres under irrigation. Virtually all of the agricultural development is confined to the Paradise Irrigation District. Agricultural lands in the district are distributed in small holdings, the majority of the tracts being from two to five acres in size. Apple-growing is the major agricultural activity, although a variety of fruits, nuts, and truck crops are grown in small quantities. In the area north of the Paradise Irrigation District little use is made of the irrigable lands. South of the district, most of the agricultural lands are used for dry pasture, but there are a few plots of irrigated pasture and orchards, and some grain hay is raised.

The Paradise Irrigation District obtains its water supply from Magalia Reservoir on Little Butte Creek. The reservoir has a storage capacity of 3,540 acre-feet. Distribution of water within the district is accomplished largely by pipe lines.

Wyandotte Service Area

Location and Physical Features. The Wyandotte Service Area is located in southeastern Butte County between the South Fork of the Feather River and the Yuba county line, and extends from Lost Creek Reservoir on the east to the route of a possible south canal from the proposed Oroville Reservoir. The canal would divert from the Feather River near Oroville, and its route would pass about two miles west of Palermo and continue in a slightly southeasterly direction to the Yuba county boundary, passing about one mile east of Honcut.

Mean seasonal depth of precipitation varies from 24 to 73 inches. Elevations range from 100 to 4,000 feet above sea level, with a large majority of the irrigable lands situated below the 1,000-foot contour. As elevation increases the topography varies from flat to rolling and hilly, becoming steep and rugged in the extreme eastern part of the area.

In the eastern portion of the Wyandotte Service Area, above 1,500 feet in elevation, alternate zones of soils of the Aiken, Holland, and Montara series-groups occur. Soils of the Holland and Auburn series-groups dominate the central part of the area. In the western portion, soils are about evenly divided between the Auburn and Goldridge-Vallecitos series-groups and various alluvial types.

The gross land area is about 117,000 acres, some 29 per cent of which is classified as irrigable. About 60 per cent of the irrigable land is rated Class 4(3) or 5(P), and most of the remainder is rated Class 4(2). Below the 1,000-foot contour the irrigable lands are somewhat scattered in occurrence, although they exist in large parcels. In the central portion of the service area the irrigable lands occur generally in small widely separated parcels, while in the highest part of the area they are fairly well concentrated.

Present Development. Most of the service area is sparsely populated, with no towns of more than one or two hundred inhabitants. In the extreme western portion, however, there is a substantial urban and suburban population in and around the City of Oroville. The population within the Oroville city limit is about 5,400, and it is estimated that at least an equal number live in the suburban Oroville-Palermo-Wyandotte region. The service area is served by the main line of the Western Pacific Railroad, and by state highways and county roads.

The land classification and land use survey conducted in 1948 listed a gross irrigable area of 34,000 acres, about 5,300 acres of which were cultivated, including 4,000 acres under irrigation. Virtually all of the cultivated and irrigated lands are located in the western part of the area, in and around the Oroville-Wyandotte Irrigation District. The principal irrigated crops in order of importance are olives, citrus fruits, and pasture. In the eastern part of the service area the principal use of the irrigable lands is for dry pasture, although some grain hay is raised for stock feed.

Present water supplies are furnished by the Oroville-Wyandotte Irrigation District by storage and diversion from the South Fork of the Feather River. The Forbestown Ditch diverts from Lost Creek Reservoir, with a storage capacity of 5,200 acre-feet, and extends through the upper part of the service area to Lake Wyandotte, a regulating reservoir with a storage capacity of 1,300 acre-feet. The Palermo Ditch diverts from the South Fork of the Feather River a short distance upstream from Enterprise. In 1949 the irrigation district reported a gross diversion of 28,000 acre-feet.

CALAVERAS COUNTY

Bear Mountain Service Area

Location and Physical Features. This service area is located in southwest Calaveras County between Gopher Ridge on the west and Bear Mountain Ridge on the east, and extends southerly from the vicinity of Hogan Reservoir and the Calaveras River to the Stanislaus River.

Mean seasonal depth of precipitation varies from 19 to 28 inches. Elevations range from 700 to 2,600 feet above sea level, but the majority of the irrigable lands are between the 1,000- and 1,500-foot contours. The topography is hilly to mountainous, except in the flat Salt Springs Valley where about one-half the irrigable lands is concentrated.

Soils are almost exclusively of the Auburn and Hugo series-groups, with minor areas of igneous intrusions on which Holland and Montara soils have been developed. The latter soils, in the southern portion of the area, are part of the largest serpentine zone in the Mother Lode Region, which zone continues southerly across Tuolumne County to the Tuolumne River.

The gross land area is about 94,000 acres, of which approximately 23 per cent is classified as irrigable land. Almost two-thirds of the gross irrigable area is defined as Class 5(P) land, and about 18 per cent has been placed in Class 2. Other than in Salt Springs Valley, the irrigable lands are widely scattered.

Present Development. Copperopolis, at one time an active mining center, is the only community within the service area, and has a present population of about 300 inhabitants. Access to the area is provided by a network of secondary state and county roads.

The land classification and land use survey conducted in 1948 showed no irrigated lands. However, a considerable area in Salt Springs Valley, near the reservoir of the same name, receives subirrigation. About 1,000 acres were planted to grain and hay crops. The remainder of the irrigable lands was devoted to dry pasture and range.

The runoff from the entire service area is controlled in Salt Springs Valley Reservoir on Rock Creek, and is used on foothill lands in Stanislaus County. The town of Copperopolis receives domestic water supplies from a small reservoir on Penney Creek, a tributary of the Stanislaus River.

Calaveras Service Area

Location and Physical Features. The Calaveras Service Area is located in central Calaveras County between the North Fork of the Calaveras River and San Domingo Creek, and extends easterly from Jenny Lind on the Calaveras River to the headwaters of that stream.

Mean seasonal depth of precipitation varies from 21 to 52 inches. Elevations range from 700 to 4,500 feet above sea level. However, most of the irrigable lands are below the 3,000-foot contour, and are widely scattered throughout the service area.

The soils are extremely variable. In the western part of the service area, soils of the Auburn and Hugo series-groups predominate in a complex pattern. To the east the soils of the Hugo series-group, developed on the Calaveras formation, are the more common. However, there are many local areas, particularly in the higher elevations, containing soils of the Holland and Aiken series-groups.

The Calaveras Service Area is dissected by the numerous east-west trending, deeply entrenched tributaries of the Calaveras River. The irrigable lands are therefore discontinuous, and exist largely on the ridges between those tributary streams.

The gross land area is about 155,000 acres, of which 11 per cent is classified as irrigable. Of the gross irrigable area of 16,700 acres, more than one-half consists of Classes 4(3) and 5(P), and the greater portion of the remainder is Class 4(2) land.

Present Development. About 20 per cent of the population of Calaveras County resides in this service area. The principal town is San Andreas, the county seat, with about 1,500 inhabitants.

The area is served by a branch line of the Southern Pacific Railroad which terminates at the Calaveras Cement Company plant near San Andreas, and by a good network of state and county roads.

In 1948 there were 230 acres under irrigation, chiefly in irrigated pasture, and an additional 720 acres were dry-farmed to grain hay crops and a few orchards.

The Calaveras Public Utility District, which diverts water from the Middle and South Forks of the Stanislaus River, serves domestic water supplies to the town of San Andreas, and to the Calaveras Cement Company. There are a number of small-scale water storage developments on various tributaries of the Calaveras River, which divert through old mining ditches to provide water supplies to small irrigated tracts and communities.

Hogan Service Area

Location and Physical Features. This service area is located in northwestern Calaveras County between the Mokelumne and Calaveras Rivers, and extends from Pardee Reservoir west to the San Joaquin county line. The area lies below possible conduits extending from Hogan Dam on the Calaveras River, where a reservoir of 325,000-acre-foot storage capacity is proposed to replace the existing structure.

Mean seasonal depth of precipitation varies from 18 to 21 inches. Elevations range from 200 to 600 feet above sea level. The topography is gently rolling, except where the "haystack mountain" type of terrain has been developed. The soils are almost entirely of the Goldridge series-group and related types, with intermingled secondary soils in a complex pattern.

The gross land area is about 44,000 acres, of which approximately 50 per cent is classified as irrigable land. The quality of the irrigable lands is generally good, 40 per cent being designated as Class 1 or 2 lands. Only about 20 per cent has been placed in the Class 4(3) or 5(P) categories. The irrigable lands are generally well concentrated.

Present Development. The Hogan Service Area is sparsely populated, with few communities of more than a hundred or so inhabitants. Lack of settlement is attributable to the fact that no water supplies, other than individual stockwatering and domestic wells, have been developed.

The area is traversed by the branch line of the Southern Pacific Railroad connecting Lodi and San Andreas. A fair network of secondary state and county roads also serve the area.

The land classification and land use survey made in 1949 showed a gross irrigable area of about 22,200 acres, of which less than 2 per cent was under irrigation. Those irrigated lands were chiefly in olives. An area of 2,390 acres was dry-farmed, with orchards and vineyards accounting for about 30 per cent of the total, and the remainder being planted principally to grain and hay. The total cultivated area amounted to about 12 per cent of the gross irrigable area. Other lands are devoted largely to dry pasture.

The few irrigated acres are served by pumping from the ground water basin close to the Calaveras River.

Mokelumne Service Area

Location and Physical Features. The Mokelumne Service Area is located in Calaveras County between the Mokelumne River and its Middle Fork and the Calaveras River and its North Fork, and extends east from the vicinity of the town of Valley Springs to the vicinity of the national forest boundary.

Mean seasonal depth of precipitation varies from 21 to 53 inches. Elevations range from 700 to 4,000 feet above sea level. About one-half the irrigable area is situated below 1,500 feet in elevation, and a majority of the remainder is between the 1,500- and 2,500-foot contours.

Soils in the western part of the service area are of the Auburn and Hugo series-groups, a complex pattern. East of that zone the soils of the Hugo series-group, developed on the Calaveras formation, are more common. However, there are many local areas, particularly in the higher elevations, containing soils of the Holland and Aiken series-groups.

The topography varies from rolling to mountainous, but on the broad ridge between the Mokelumne and Calaveras Rivers, where most of the irrigable lands are located, slopes are quite gentle. Relatively smooth areas also exist on low lands near the towns of Valley Springs and Railroad Flat.

The gross land area is about 83,000 acres, of which 19 per cent is classified as irrigable. The irrigable lands, amounting to about 16,000 acres, are more or less equally divided between the better land classes, Class 4(2) and higher, and the poorer land classes, Classes 4(3) and 5(P).

Present Development. About 15 per cent of the population of Calaveras County is resident in the Mokelumne Service Area. The principal town and business center is Mokelumne Hill, a community of about 600 inhabitants.

A branch line of the Southern Pacific Railroad from Lodi to San Andreas traverses the western portion of the service area, and passes through the town of Valley Springs. There is a fair network of secondary state and county roads.

The total cultivated area in 1948 was less than 5 per cent of the gross irrigable area of over 16,000 acres. Virtually all of the 250 acres under irrigation were devoted to irrigated pasture, and an additional 450 acres were dry-farmed, principally to grain and hay.

The Calaveras Public Utility District diverts from the Middle and South Forks of the Mokelumne River, and delivers domestic water supplies to Mokelumne Hill and San Andreas. Some incidental irrigation water is delivered along the route of the district's ditch. The amount of this diversion is limited to about 9,000 acre-feet per year, pursuant to an agreement between the East Bay Municipal Utility District and the Calaveras Public Utility District. The system includes, in addition to the direct diversion works, a reservoir on the Middle Fork of the Mokelumne River with a storage capacity of about 1,700 acre-feet.

Rock Creek Service Area

Location and Physical Features. This service area is located in southwest Calaveras County, extending west into Stanislaus County between the Stanislaus and Calaveras Rivers. The eastern boundary of the area is Gopher Ridge, and the western boundary is along the tentative location of a foothill conduit extending north from a possible diversion point on the Stanislaus River below the New Melones dam site. About 76 per cent of the service area is in Calaveras County.

Mean seasonal depth of precipitation varies from 17 to 22 inches. Elevations range from 500 to 1,500 feet above sea level. Most of the irrigable lands are below the 1,000-foot contour. The topography is of the rolling foothill type, becoming rugged on the slopes of Gopher Ridge.

Soils in the service area are largely of the Auburn series-group, except along the western margin where Goldridge series-group soils, developed on the Valley Springs formation, are encountered.

The gross land area is about 55,000 acres, of which 15 per cent is classified as irrigable. Calaveras County contains 70 per cent of the irrigable lands, and the remaining 30 per cent are in Stanislaus County. The agricultural lands are of relatively poor quality, 70 per cent being defined as Class 4(3) or 5(P). The irrigable lands are widely scattered throughout the service area.

Present Development. The only settlement within the Rock Creek Service Area is the town of Milton, a community of about 150 inhabitants. The area is served by a few secondary roads.

The gross irrigable area is nearly 8,500 acres, and in 1948 about 820 acres were under cultivation to grain and hay. There were no irrigated lands in the service area at that time. About 82 per cent of the cultivated area is in Stanislaus County.

Stanislaus Service Area

Location and Physical Features. The Stanislaus Service Area is located in southeast Calaveras County between the North Fork of the Stanislaus River and San Domingo Creek, and extends from Bear Mountain Ridge east to the vicinity of Dorrington on the Ebbetts Pass highway.

Mean seasonal depth of precipitation varies from 26 to 53 inches. Elevations range from 1,000 to 4,500 feet above sea level, but virtually all the irrigable lands are below the 2,000-foot contour. The topography is generally hilly to rugged, but slopes are gentle along many of the local streams in the vicinity of Angels Camp and Altaville and on the ridge tops at the higher elevations.

In the western part of the service area, soils of the Auburn and Hugo series-group predominate in a complex pattern. In the eastern part, soils of the Hugo, Holland, and Aiken series-groups are present in irregular but more or less continuous areas.

The gross land area is about 85,000 acres, of which about 16 per cent is classified as irrigable. About 58 per cent of the irrigable land in the service area is defined as Class 4(2) or better. The irrigable lands are scattered in small parcels, with the exception of a few relatively large continuous bodies of irrigable land in the eastern and western extremities of the service area.

Present Development. About one-third of the 10,000 inhabitants of Calaveras County reside in the Stanislaus Service Area. The principal town and business center is Angels Camp, with a population of about 1,200.

The nearest railroad is the branch line of the Southern Pacific Railroad terminating near San Andreas. The area is served by a good network of secondary state and county roads.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 13,350 acres, of which 810 acres were under irrigation and an additional 990 acres were dry-farmed. About 90 per cent of the irrigated land was in pasture, and the remainder was in orchards. The principal dry-farmed crop was grain hay.

The Utica Ditch System, now being operated by the Pacific Gas and Electric Company, serves Angels Camp and other communities in that vicinity with domestic water supplies, and also furnishes limited supplies for irrigation use to various areas through old mining ditches. A majority of the water diverted from the North Fork of the Stanislaus River through the Utica Ditch is used for the generation of hydroelectric energy, through the Murphys and Angels Camp Power Plants, and is returned to the Stanislaus River by way of Angels Creek.

West Point Service Area

Location and Physical Features. This service area is located in northern Calaveras County between the North and Middle Forks of the Mokelumne River, and extends east from the junction of those streams to a point about one mile east of the national forest boundary.

Mean seasonal depth of precipitation varies from 32 to 51 inches. Elevations range from 1,500 to 4,000 feet above sea level. Most of the irrigable lands are between the 2,500- and 3,000-foot contours and lie in the general vicinity of the town of West Point. The topography is quite irregular and generally steep, except on the broad ridge between the forks of the Mokelumne River, where the irrigable lands are located.

The soils are largely of the Holland series-group. Along the eastern boundary of the service area, Aiken series-group soils have been developed on volcanic materials overlying granitic formations.

The gross land area is about 32,000 acres, of which less than 10 per cent has been classified as irrigable. The quality of the irrigable lands is good, approximately 75 per cent being described as Class 4(2) land.

Present Development. This service area is sparsely settled, and the principal urban activity centers about the town of West Point and nearby lumber mills. The area is served by secondary county roads.

The gross irrigable area is about 3,140 acres, of which 10 per cent was under cultivation in 1948. The cultivated area included 220 acres of dry-farmed orchards and 100 acres of irrigated pasture and orchards.

The town of West Point and the lumber mills obtain their present water supply by canal from Forest Creek, a tributary of the Middle Fork of the Mokelumne River. Due to lack of terminal storage facilities and to the poor condition of the ditch, the present water supply is inadequate. Irrigation water is obtained from small reservoirs owned by individual farmers.

EL DORADO COUNTY

Aukum Service Area

Location and Physical Features. The Aukum Service Area is located in southern El Dorado County between the South and Middle Forks of the Cosumnes River, and extends east from the junction of the forks to the vicinity of Omo Ranch.

Mean seasonal depth of precipitation varies from 28 to 48 inches. Elevations range from 1,000 to 3,500 feet above sea level, with the majority of the irrigable lands situated between the 2,000- and 3,000-foot levels. Topography is generally hilly to mountainous, with moderate slopes atop the ridges and with a fairly heavy cover of brush and timber.

Soils in the eastern third of the service area are of the Aiken series-group, and soils of the Holland series-group occupy the remainder of the area. The majority of the irrigable lands have soils of the Holland series-group.

The gross land area is about 58,000 acres, about 18 per cent of which is classified as irrigable land. The irrigable lands are of fair quality, being almost evenly divided between the 4(2) and 4(3) classifications. The irrigable lands are generally dispersed in occurrence, except in the vicinity of Fair Play where more than one-third of the lands is concentrated.

Present Development. The Aukum Service Area is thinly populated, with no settlements of more than a few score of inhabitants. Access is provided by secondary county roads, generally in poor condition.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 10,500 acres, less than 200 acres of which were cultivated. No land was irrigated at the time of the survey. Cultivated lands were devoted to orchards and vineyards.

Georgetown Service Area

Location and Physical Features. This service area is located in northwest El Dorado County on the ridge between the South and Middle Forks of the American River. From the confluence of the forks, the area extends east to the boundary of the Eldorado National Forest.

Mean seasonal depth of precipitation varies from 25 to 56 inches. Elevations range from 1,000 to 3,000 feet above sea level, and the irrigable lands are about evenly distributed between these limits. Topography changes from rugged and precipitous along the deep canyons of the American River to rolling and somewhat hilly atop the broad ridge of the Georgetown Divide.

There is considerable variation in soil types in the service area. Soils of the Auburn and Hugo series-groups predominate in the western and eastern portions, while soils of the Hugo-Auburn complex predominate in the central portion. Limited zones of the Holland, Aiken, and Montara soil series-groups are scattered throughout the area.

The gross land area is about 116,000 acres, less than 14 per cent of which is classified as irrigable land. Almost two-thirds of the irrigable lands are rated Class 4(3) or 5(P), the poorest types. The majority of the remainder is listed as Class 4(2). The irrigable lands along the Georgetown Divide between Georgetown and Cool, and in the area just west of Traverse Creek, are fairly well concentrated, but in other parts of the service area they are widely scattered in small parcels.

Present Development. It is estimated that approximately 2,000 persons live in the Georgetown Service Area. The principal town and business center is Georgetown, with a population of about 600. The area is served by a fair network of secondary roads.

The land classification and land use survey conducted in 1949 showed an irrigated area of almost 1,600 acres, about 10 percent of the gross irrigable area of 15,600 acres. The irrigated lands were devoted to orchards and pasture. An additional cultivated area of about 740 acres was dry-farmed, principally in orchards and grain hay. Other lands in use were devoted to dry pasture.

Irrigation and domestic water is supplied to the service area by the Georgetown Divide Public Utility District. Water is stored in Loon Lake, in the upper basin of the Rubicon River, and conveyed to the service area through a ditch system some 40 miles long. Conveyance losses are high, but additional water is picked up enroute by direct diversion from the Little South Fork of the Rubicon River and from Pilot Creek. Average seasonal deliveries are about

10,000 acre-feet. The present supply is inadequate to satisfy present demands for water, both domestic and irrigation.

Latrobe Service Area

Location and Physical Features. The Latrobe Service Area is located in southwest El Dorado County, extending from a possible canal route north from the proposed Nashville Reservoir on the Cosumnes River to the Sacramento county boundary. The canal route extends generally northwest from the Nashville dam site, passing slightly west of Latrobe and Cothrin, and reaching the Sacramento county line in the vicinity of Clarksville.

Mean seasonal depth of precipitation varies from 21 to 27 inches. Elevations range from 400 to 900 feet above sea level. The terrain is rolling to hilly, with sparse cover.

The majority of the soils in the service area are of the Auburn series-group. Limited zones of soils of the Hugo and Montara series-groups are also represented.

The gross land area is about 20,000 acres, approximately one-third of which is classified as irrigable. The over-all suitability of the irrigable lands is poor, almost 80 per cent being rated Class 4(3) or 5(P). Most of the irrigable lands are fairly well concentrated in the lower part of the area along the Sacramento county boundary.

Present Development. The Latrobe Service Area is sparsely populated. Latrobe, a community of about 225 inhabitants, and Clarksville with about 200, are the only towns of recordable size. The area is served by a branch of the Southern Pacific Railroad from Sacramento to Placerville, and by secondary county roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 6,600 acres, and a total cultivated area of less than 200 acres, all in dry farms. The cultivated lands were planted to grain hay. Other agricultural lands in use were devoted to dry pasture.

Placerville Service Area

Location and Physical Features. This service area is located in El Dorado County between the South Fork of the American River and the North Fork and main stream of the Cosumnes River. The area extends from the vicinity of Pacific on the east to the Sacramento county boundary on the northwest, and to the route of a possible canal extending northwesterly from the proposed Nashville Reservoir to near Folsom Reservoir.

Mean seasonal depth of precipitation varies from 24 to 44 inches. Elevations range from 400 to 4,000 feet above sea level, with the majority of the irrigable lands situated between 1,500 and 3,000 feet in elevation. Topography varies from the rolling foothill type at the lower elevations to mountainous terrain in the eastern portion.

East of Placerville, soils of the Aiken series-group predominate, although limited zones of soils of the Holland and Hugo series-groups also occur. West of Placerville, soils of the Auburn series-group predominate, but large areas of soils belonging to the Holland series-group and to the Hugo-Auburn complex occur, and there are small local zones of Montara soils.

The gross land area is about 238,000 acres, 21 per cent of which is classified as irrigable land. The irrigable lands are of fairly good quality, more than half the gross irrigable area being rated Class 4(3) or better. Within the El Dorado Irrigation District the agricultural lands are fairly well concentrated. In the remainder of the service area, however, they are widely dispersed, but they do occur generally in rather large parcels.

Present Development. The present population of the Placerville Service Area is estimated to be more than 10,000. The largest town and business center is Placerville, with a population of 3,750, the county seat.

Transportation facilities are excellent. A branch of the Southern Pacific Railroad connects Placerville with Sacramento, and U. S. Highway 50 traverses the long axis of the area. A good network of secondary roads provides adequate access to other parts of the area.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 50,900 acres, of which 8,600 acres were cultivated, including 6,000 acres under irrigation. Virtually all of the irrigated lands were in the El Dorado Irrigation District, located in the north central part of the service area in the vicinity of Placerville. Pear orchards accounted for the majority of the irrigated acreage. The principal crops grown on the dry-farmed lands were grain hay and orchards. Other agricultural lands were devoted to dry pasture.

Until recently, the El Dorado Irrigation District obtained the bulk of its water supply from the South Fork of the American River by means of facilities of the Pacific Gas and Electric Company. A small quantity of water was also diverted from the unregulated flow of the North Fork of the Cosumnes River, and a limited supply was obtained from a small reservoir on Webber Creek. However, in 1954 the district more than doubled its former water supply when the Sly Park Project on the North Fork of the Cosumnes River was completed. The district furnishes domestic and municipal water to the towns of Placerville and Camino, and to other domestic users along the route of the El Dorado Canal. The average seasonal water supply available to the district at present is about 15,000 acre-feet.

Youngs Service Area

Location and Physical Features. This service area is located in El Dorado County between the North and Middle Forks of the Cosumnes River and west of the Eldorado National Forest.

Mean seasonal depth of precipitation varies from 28 to 46 inches. Elevations range from 1,000 to 4,000 feet above sea level, with most of the irrigable lands situated between the 2,000- and 3,000-foot levels. The terrain is hilly to mountainous, with a fairly heavy cover of timber and brush. Slopes atop the ridge between the South and Middle Forks of the Cosumnes River are moderate.

The majority of the soils in the service area are of the Holland series-group. In the extreme western and eastern portions, soils of the Aiken series-group occur. The great majority of the irrigable lands, however, have soils of the Holland series-group.

The gross land area is about 46,000 acres, about 16 per cent of which is classified as irrigable land. The irrigable lands are generally poor in quality, about two-thirds of them being rated Class 4(3) land. The remainder is rated Class 4(2) land. Most of the irrigable lands are fairly well grouped in the vicinity of Coles, Youngs, and Grizzly Flat.

Present Development. The Youngs Service Area is sparsely populated, with few communities of more than a hundred or so inhabitants. Transportation facilities consist of secondary county roads in generally poor condition.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 7,400 acres, including about 150 acres under cultivation. No lands were irrigated. Cultivated lands were devoted principally to grain hay and orchards. Other lands were used for stock grazing, or were not in use at all.

MARIPOSA COUNTY

Baxter Service Area

Location and Physical Features. The Baxter Service Area is located in northwest Mariposa County and northeast Merced County, between the Merced River on the south and the Tuolumne and Stanislaus county boundaries on the north, and extends from the vicinity of Coulterville to a proposed foothill conduit line. This conduit route is located in Merced County at distances varying from three to six miles west of the Mariposa county line.

Mean seasonal depth of precipitation varies from 14 to 26 inches. Elevations range from 400 to 2,500 feet above sea level, with virtually all of the irrigable land situated below the 1,500-foot contour. The topography is generally rolling to hilly, with large areas of open grasslands at the lower elevations.

In the Mariposa County portion of the service area, soils are of the Hugo and Auburn series-groups, the latter type predominating. Along the western boundary of the area in Merced County, however, soils are of the Goldridge and Vallecitos series-groups. A small zone of alluvial types of soil borders the Merced River.

The gross land area is about 58,000 acres, of which approximately 15 per cent is classified as irrigable land. Slightly more than half the irrigable land is in Merced County, which contains only 34 per cent of the gross area of the service area. The irrigable lands are generally poor in quality, more than 71 per cent being rated as Classes 5(P) and 4(3). Most of the better types are in the Merced County section. The pattern of irrigable land is one of wide dispersion throughout the area.

Present Development. The Baxter Service Area is very sparsely populated. Merced Falls, a town of about 800 population, is the only settlement of any consequence. The area is served by secondary state and county roads.

According to the land use and land classification survey conducted in 1949, about 700 acres were cultivated, including 390 acres under irrigation. All of the irrigated lands and virtually all of the remaining cultivated lands were in Merced County. The irrigated lands were in pasture, and the dry-farmed lands were planted almost exclusively to grain hay. Other agricultural lands in use were devoted to cattle grazing.

The present water supplies within the service area are obtained by small individual developments on local streams.

Chowchilla Service Area

Location and Physical Features. This service area may be described generally as that part of the Chowchilla River watershed within Mariposa County. It occupies a long, narrow strip of southern Mariposa County, extending from the vicinity of Devils Peak on the east to a proposed foothill conduit line on the west. Since this conduit route is located slightly west of the Mariposa-Merced county boundary, the service area includes a small zone in Merced County.

Mean seasonal depth of precipitation varies from 12 to 39 inches. Elevations range from 400 to 5,000 feet above sea level, with about one-third of the irrigable land situated between 2,500 and 3,500 feet, and the balance at lower elevations. The topography is generally rolling to hilly, with no rugged slopes except in the extreme eastern part of the area.

Virtually all of the soils in the service area are of the Hugo or Holland series-groups, the latter type predominating in the eastern section and the former covering the western portion of the area. Soils of the Auburn series-group occur in small zones in the central portion, and a narrow strip of soils of the Goldridge-Vallecitos series-groups is located along the route of the foothill conduit.

The gross land area is about 126,000 acres, of which less than 12 per cent is classified as irrigable land. More than 98 per cent of the gross area and about 96 per cent of the irrigable lands are in Mariposa County. The quality of the irrigable lands is generally poor, about 75 per cent being rated as Class 4(3) or 5(P), and less than 4 per cent as Class 3 or better. The largest contiguous body of irrigable land in Mariposa County is located in the vicinity of Magoon Hill, but the majority of the irrigable lands in the service area are widely dispersed.

Present Development. The Chowchilla Service Area is very thinly settled, with no towns or communities of significance. Access is provided by a network of secondary state and county roads.

The land classification and land use survey conducted in 1949 showed less than 600 acres under cultivation, including 280 acres under irrigation. Almost all of the irrigated lands were in one orchard situated near Magoon Hill. The remainder of the cultivated lands were planted to grain, hay, or orchard. All of the cultivated lands were in Mariposa County.

Present water supplies in the service area are obtained from small individual developments on local streams, and from domestic and stockwatering wells.

Hardin Service Area

Location and Physical Features. The Hardin Service Area is located in Mariposa County between the Merced River and the Tuolumne county boundary, and extends from the vicinity of Coulterville on the west to Pilot Peak on the east.

Mean seasonal depth of precipitation varies from 27 to 45 inches. Elevations range from 1,000 to 6,000 feet above sea level, with about two-thirds of the irrigable lands situated between the 3,000- and 3,500-foot contours.

From the boundary of the Stanislaus National Forest to the eastern limits of the service area, virtually all of the soils are of the Aiken series-group. West of the national forest boundary the majority of the soils belong to the Auburn series-group. In this part of the service area there are limited zones of soils of the Hugo, Holland, and Montara series-groups. The irrigable land is about evenly split between the Aiken and the Auburn series-groups.

Topography throughout most of the area is fairly rugged, particularly along the major stream courses. The majority of the irrigable lands are located on the gently sloping plateau in the northern part of the area between Coulterville and the North Fork of the Merced River.

The gross land area is about 126,000 acres, less than six per cent of which is classified as irrigable land. The irrigable lands are of fairly good quality, with more than 55 per cent rated as Class 4(2) or better, and about 37 per cent rated as Class 4(3). About two-thirds of the irrigable land is fairly well concentrated in the vicinity of Bean and Smith Creeks. The remainder is widely scattered in small parcels.

Present Development. The Hardin Service Area is sparsely populated throughout. The only town of significance is Coulterville, a community of about 400 inhabitants.

Adequate access to the area is provided by a network of secondary state and county roads which link Coulterville with the main highway to Yosemite National Park, and with points in Tuolumne and Merced Counties.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 6,700 acres, with less than 300 acres cultivated, including 20 acres of irrigated pasture. Dry-farmed lands were in grain hay or deciduous orchard.

Present water supplies in the service area are obtained from wells and springs, and from limited individual development of local creeks.

Hornitos Service Area

Location and Physical Features. The Hornitos Service Area is located in western Mariposa County and eastern Merced County between the Merced River and Owens Creek, and extends from the Guadalupe Mountains on the east to a proposed foothill conduit line on the west. South of the Merced River, this conduit route coincides very nearly with the boundary between Mariposa and Merced Counties, except in the first few miles where it extends some nine miles into Merced County, circling the high ground in the vicinity of China Hat Hill.

Mean seasonal depth of precipitation varies from 13 to 22 inches. Elevations range from 400 to 2,800 feet above sea level, but most of the irrigable lands are below the 1,500-foot contour.

Soils in the Merced County section of the service area belong exclusively to the Goldridge-Vallecitos series-groups. Soils in the Mariposa County portion are about evenly divided between the Hugo and the Auburn series-groups, but there are a few zones of limited extent where the Holland series-group is represented.

The topography is generally rolling to hilly, with steep slopes in the eastern portions of the service area. Slopes are moderate in local areas such as the Cathay Valley and the Hornitos and El Dorado Creek Valleys where most of the irrigable lands are located.

The gross land area is about 136,000 acres, of which less than 14 per cent is classified as irrigable land. More than 76 per cent of the gross area, including about 83 per cent of the irrigable land, is in Mariposa County. The poorer classes of land predominate, about 94 per cent of the irrigable lands being rated Class 4(3) or 5(P). The irrigable lands are generally dispersed throughout the service area, although there are two fairly large bodies east of Hornitos and another in the Cathay Valley.

Present Development. The population of the service area is scattered and sparse. Hornitos, a community of some 200 inhabitants, is the largest settlement. The area is served by the all-year highway from Merced to Yosemite National Park, and by secondary county roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 18,600 acres, none of which was irrigated, and less than 200 acres of which was cultivated in dry farms. Most of the cultivated area was planted to grain hay. The principal use of the irrigable lands was for dry pasture.

Mariposa Service Area

Location and Physical Features. The Mariposa Service Area is located in central Mariposa County south of the Merced River, and extends from the vicinity of Mariposa and Briceberg northwest to Exchequer Reservoir.

Mean seasonal depth of precipitation varies from 21 to 37 inches. Elevations range from 1,000 to 3,500 feet above sea level, with most of the irrigable lands situated below the 2,500-foot contour.

The soil pattern in the service area is characterized by alternating zones of the Auburn and Hugo series-groups, with a large area of Aiken soils in the northeast section and a smaller area of soils of the Holland series-group in the southwest section.

The topography is fairly rugged throughout a large part of the service area. With the exception of the Bear Valley district, areas where slopes are moderate are of very limited extent.

The gross land area is about 113,000 acres, of which only four per cent is classified as irrigable land. More than 81 per cent of the irrigable lands are rated as Class 4(3) or 5(P), the poorest types, and they are badly scattered in small parcels throughout the service area.

Present Development. The principal town and business center in the Mariposa Service Area is Mariposa, the county seat, a community of about 650 inhabitants. The remainder of the service area is sparsely settled.

The area is served by the all-year highway from Merced to Yosemite National Park, and by secondary connecting roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 4,800 acres. Less than 200 acres were cultivated, including a few small irrigated plots. The principal crops grown were grain hay and deciduous orchard. The irrigable lands were used primarily for cattle grazing.

Present water supplies in the service area are obtained from small developments of local streams, and from wells and springs.

White Rock Service Area

Location and Physical Features. This service area is located in southwest Mariposa County between the Owens Creek watershed on the north and the Chowchilla River watershed on the south, and extends from the vicinity of Moore Hill on the east to a proposed foothill conduit line on the west. This conduit route is located within a mile or so of the boundary between Mariposa and Merced Counties. Most of the service area is within the Mariposa Creek watershed.

Mean seasonal depth of precipitation varies from 13 to 22 inches. Elevations range from 400 to 2,600 feet above sea level, but most of the irrigable lands are situated below the 1,000-foot contour.

Virtually all of the soils in the service area belong to the Hugo series-group. There is a small zone of soils of the Auburn series-group in the eastern portion, and a very narrow strip of the Goldridge-Vallecitos series-groups along the extreme western limit of the area.

The topography is generally hilly throughout the area, but slopes are quite flat along the western boundary and in the district just east of White Rock Mountain. These are the zones where the irrigable land is situated.

The gross land area is about 57,000 acres, less than nine per cent of which is classified as irrigable. About two-thirds of the irrigable lands are rated as Class 4(3) or 5(P). Most of the irrigable lands are located along Ganns Creek and lower Mariposa Creek in fairly large contiguous parcels.

Present Development. The service area is virtually uninhabited, with no settlements of recordable size anywhere in the area. A network of secondary county roads provides adequate access to the area.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 4,900 acres, with less than 400 acres cultivated, including about 50 acres of irrigated pasture. The dry-farmed lands were planted in grain and hay. Most of the other irrigable lands were used for dry pasture.

Present water supplies in the service area are obtained from small developments of local creeks, and from domestic and stock-watering wells.

NEVADA COUNTY

Grass Valley Service Area

Location and Physical Features. The Grass Valley Service Area is located in Nevada County between the Bear River and the South Fork of the Yuba River, and extends from the Yuba county boundary to a point about five miles east of Nevada City. The service area constitutes the Nevada County unit of the Nevada Irrigation District.

Mean seasonal depth of precipitation varies from 26 to 63 inches. Elevations range from 300 to 3,500 feet above sea level. The terrain is generally hilly throughout most of the service area, but slopes are moderate along local streams and atop many of the ridges.

The soil pattern in the service area is highly variable. Major soils are those of the Aiken, Auburn, and Holland series-groups. Aiken soils predominate in the eastern portion of the area, Auburn soils cover west of the central and southwest portions, and Holland soils occupy the northwest portion except for a large zone of Auburn soils along the Yuba county line north of Dry Creek. In the locality directly northwest of Grass Valley there is a complex pattern consisting of limited zones of soils of the Aiken, Holland, and Montara series-groups, and including small areas of alluvial soils.

The gross land area is about 219,000 acres, 24 per cent of which is classified as irrigable land. The overall quality of the irrigable lands is only fair, about 62 per cent of the total irrigable area being rated Class 4(3). Most of the remainder is described as Class 4(2). In general, the irrigable lands are widely dispersed in occurrence. In the vicinity of Penn Valley and in the Nevada City-Grass Valley-Chicago Park region, however, they are fairly well concentrated. Almost 5,000 acres of irrigable land in the extreme western part of the service area are inside the Camp Beale Military Reservation. None of these lands on the reservation are irrigated at present, and it is possible that, due to military restrictions, none will be irrigated at any time in the future.

Present Development. Grass Valley and Nevada City, the largest towns in Nevada County, are located in the eastern part of the service area. Nevada City, the county seat, has a population of 2,500, and Grass Valley has 5,300. The rural and suburban population of the service area is substantial, particularly in the Nevada City-Grass Valley region. Adequate transportation facilities are provided by a good network of state and county roads.

Due to the development and operation of the Nevada Irrigation District, the service area is one of the most important agricultural districts in the entire Mother Lode Region. The land classification and land use survey conducted in 1949 showed a gross irrigable area of 52,000 acres, of which about 6,500 acres were under irrigation. Pasture and orchards were the principal irrigated crops, the former accounting for about 75 per cent of the total. The area cultivated in dry farms was insignificant, but a large part of the noncultivated agricultural land was used for dry pasture.

Present water supplies for irrigation and domestic use in the service area are furnished by the Nevada Irrigation District. The district has an extensive storage and diversion system on the Middle Fork of the Yuba River, Canyon Creek, Deer Creek, and the Bear River. Hydroelectric energy is produced and disposed of by contract with the Pacific Gas and Electric Company.

Spaulding Service Area

Location and Physical Features. This service area is located in Nevada County between the Bear River and the South Fork of the Yuba River and east of the Nevada Irrigation District.

Mean seasonal depth of precipitation varies from 48 to 68 inches. Elevations range from 2,000 to 4,000 feet above sea level, with virtually all of the irrigable lands situated above the 3,000-foot contour. The topography is hilly to mountainous, with a fairly heavy timber cover, and there are moderate slopes atop the principal ridges.

Soils of the Aiken series-group cover most of the service area. Alluvial soils and soils of the Holland and Montara series-groups occur in local zones of very limited extent.

The gross land area is about 40,000 acres, less than nine per cent of which is classified as irrigable. The irrigable lands are of fair quality, almost 57 per cent being rated class 4(2). The remainder is rated Class 4(3). More than half the irrigable lands are fairly well concentrated in the Harmony Ridge District, and most of the remaining are located a short distance east of Banner Hill.

Present Development. The population of the Spaulding Service Area is sparse and scattered, and there are no towns of recordable size. Transportation facilities consist of a fairly good network of state and county roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 3,400 acres, with none under irrigation, and only a few acres cultivated in dry farms.

Tyler Service Area

Location and Physical Features. The Tyler Service Area is located in Nevada County between the South and Middle Forks of the Yuba River, and extends east from the confluence of the forks to the vicinity of North Bloomfield.

Mean seasonal depth of precipitation varies from 36 to 65 inches. Elevations range from 600 to 4,000 feet above sea level, with the majority of the irrigable lands situated between the 1,500- and 3,000-foot levels. The topography is fairly rugged along the cañyons of the Middle and South Forks of the Yuba River, but slopes atop the broad ridge between the two streams are moderate.

In the eastern half of the service area soils of the Aiken series-group predominate, but small zones of alluvial soils and of Montara soils also occur. Soils of the Holland series-group cover most of the western half of the area. Limited zones of soils of the Aiken series-group exist, and there is one small zone where alluvial soils are found.

The gross land area is about 57,000 acres, seven per cent of which is classified as irrigable. More than 75 per cent of the irrigable lands are rated as Class 4(3) or 5(P), and virtually all of the remainder is rated Class 4(2). The irrigable lands occur in small parcels, widely dispersed throughout the service area.

Present Development. The Tyler Service Area is sparsely populated, with no communities of more than a hundred or so inhabitants. The area is adequately served by secondary state and county roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 4,000 acres, with less than 200 acres under cultivation. Most of the cultivated land was in irrigated pasture. The only other utilization of irrigable lands was for dry pasture.

Water supplies for the small area presently under irrigation is obtained by small individual developments on local streams.

PLACER COUNTY

Colfax Service Area

Location and Physical Features. This service area is located in Placer County between the Bear River and the North Fork of the American River, and extends southwest from the vicinity of Blue Canyon to the boundary of the Placer County unit of the Nevada Irrigation District in the vicinity of Auburn.

Mean seasonal depth of precipitation varies from 30 to 61 inches. Elevations range from 750 to 4,500 feet above sea level, with about 75 per cent of the irrigable lands situated below the 3,000-foot contour.

In the upper half of the service area, where about one-third of the irrigable lands are located, soils of the Aiken series-group predominate, and limited zones of soils of the Holland and Montara series-groups occur. In the lower half of the area, the soils are about equally divided between the Hugo and the Auburn series-groups and the Hugo-Auburn complex. Topography varies from mountainous and precipitous along the deep canyons of the Bear River and the North Fork of the American River to rolling and hilly atop the ridge between the two streams.

The gross land area is about 90,000 acres, about 17 per cent of which is classified as irrigable. About two-thirds of the irrigable land is rated Class 4(3), and virtually all the remainder is described as Class 4(2). Although they occur in fairly large parcels, the irrigable lands are generally scattered and dispersed throughout the area, with the majority of the better types located above the 3,000-foot level.

Present Development. The Colfax Service Area is one of the most populous in the entire Mother Lode Region. The principal town and business center is Auburn, with a population of about 4,700, the county seat of Placer County. Other towns of note are Colfax, Gold Run, Dutch Flat, and Weimar. The area has a substantial rural and suburban population.

The area is served by U. S. Highway 40, and by the main line of the Southern Pacific Railroad. In addition to these major transcontinental arteries, the area is served by a number of secondary roads.

The land classification and land use survey conducted in 1949 showed a gross irrigable area of 15,400 acres, of which 4,400 acres were cultivated including about 3,700 acres under irrigation. Cultivated lands, both irrigated and nonirrigated, were devoted principally to deciduous orchards.

Present irrigation and domestic water supplies for the service area are furnished by the Pacific Gas and Electric Company by means of the Bear River Canal and the Boardman Canal. The company develops water from the Yuba, Bear, and American Rivers for use in its Bear River hydroelectric system, and for irrigation and domestic use in Placer County.

Doty Service Area

Location and Physical Features. The Doty Service Area is located north and west of Auburn, and may be defined generally as the Placer County unit of the Nevada Irrigation District. The west boundary of the district is very nearly coincident with a projected location of a north canal from Folsom Reservoir on the American River.

Mean seasonal depth of precipitation varies from 20 to 35 inches. Elevations range from 150 to 1,500 feet above sea level. The terrain is rolling to hilly in character, with large open areas in the western portion of the service area.

Soils of the Auburn series-group occupy most of the service area, but there is a major zone of soils of the Holland series-group in the southwestern portion. In the extreme western portion, soils of old to recent alluvial origin occur.

The gross land area is about 95,000 acres, almost 52 per cent of which is classified as irrigable land. Slightly less than half the gross irrigable area is rated Class 4(2) or better, and most of the remainder is Class 4(3). With the exception of a few isolated parcels in the northeast part of the area, the irrigable lands are well concentrated.

Present Development. The leading town and business center in the Doty Service Area is Lincoln, a community of about 2,500 inhabitants, and there is a substantial rural and suburban population. Transportation facilities are good. The area is served by the Southern Pacific Railroad, U. S. Highway 99E, and a network of secondary roads.

The advanced stage of agricultural development in the service area is shown by the land classification and land use survey conducted in 1949. According to the survey, the gross irrigable area is 49,400 acres, of which 17,200 acres were cultivated, including 12,600 acres under irrigation. The irrigated lands constituted more than 25 per cent of the gross irrigable area. Orchards and pasture accounted for virtually all of the irrigated crops, while grain hay was the leading dry-farmed crop.

Almost all of the irrigated lands in the Doty Service Area receive water from the Nevada Irrigation District. The district develops the bulk of its water supply from the upper watersheds of the South and Middle Forks of the Yuba River. A minor part is obtained from the Bear River. A few lands in the service area obtain water by pumping from wells.

Foresthill Service Area

Location and Physical Features. This service area is located in Placer County on the broad ridge between the North and Middle Forks of the American River, and extends northeast from their confluence to the vicinity of Michigan Bluff and Big Reservoir.

Mean seasonal depth of precipitation varies from 36 to 61 inches. Elevations range from 1,000 to 4,000 feet above sea level, with the bulk of the irrigable land situated above the 2,500-foot level. Topography along the deep canyons of the North and Middle Forks of the American River is rugged and precipitous, but on top of the broad ridge between the two streams the slopes are moderate.

Soils of the Aiken series-group cover most of the service area. Soils of the Hugo, Holland, and Montara series-groups occur in zones of very limited extent, and there is one small area of soils of the Hugo-Auburn complex.

The gross land area is about 83,000 acres, of which about 18 per cent is classified as irrigable land. Although small in extent, the irrigable lands are of good quality, about 86 per cent being rated Class 4(2) and the remainder Class 4(3). The irrigable lands are well concentrated, about two-thirds of them occurring in one contiguous body extending along the ridge from the vicinity of Michigan Bluff to McKeon. Most of the other irrigable lands are concentrated on the ridge between Indian and Shirttail Creeks.

Present Development. It is estimated that about 1,200 people live in the Foresthill Service Area, chiefly in and around the town of Foresthill. Transportation facilities are poor. The area is served by secondary roads only, many in poor condition, and some are subject to stoppage during periods of severe winter weather.

There is little agricultural activity in the service area. The land classification and land use survey conducted in 1949 showed a gross irrigable area of 15,400 acres, of which less than 100 acres were cultivated, including a few acres under irrigation. Most of the irrigable lands in use were devoted to dry pasture.

There is an acute shortage of water for domestic and industrial use in and near the town of Foresthill. The existing water supply, which is obtained from springs, is not sufficient to satisfy the most fundamental demands for water.

Loomis Service Area

Location and Physical Features. The Loomis Service Area is located in southern Placer County between the North Fork of the American River and the route of the proposed Folsom North Canal, and extends from the vicinity of Auburn and Lincoln south to the Sacramento county line.

Mean seasonal depth of precipitation varies from 19 to 31 inches. Elevations range from 150 to 1,100 feet above sea level. The topography varies from gently rolling to somewhat hilly as elevation increases.

Most of the lands in the service area have soils of the Holland series-group. In the extreme northeastern portion and along the western fringe, soils of the Auburn series-group occur in small zones of limited extent. Small areas of alluvial soils also occur along the western boundary of the service area.

The gross land area is about 50,000 acres, about 65 per cent of which is classified as irrigable. The quality of the irrigable lands is fairly good, more than 68 per cent being rated Class 4(2) or better. Virtually all of the remainder is described as Class 4(3) land. The irrigable lands are generally well concentrated in occurrence.

Present Development. The Loomis Service Area has a substantial rural population, as well as a number of small towns. The largest community is Newcastle, a town of about 1,500 inhabitants. Other towns are Loomis, Rocklin, and Penryn. Auburn and Roseville, the largest towns in Placer County, are just outside the boundaries of the area.

Transportation facilities are excellent. The area is served by the main line of the Southern Pacific Railroad, by U. S. Highway 40, and by a good network of secondary roads.

Agricultural activities are highly developed. The land classification and land use survey conducted in 1949 showed a gross irrigable area of 32,600 acres, of which about 17,000 acres were cultivated, including more than 12,000 acres under irrigation. Deciduous orchards accounted for about 89 per cent of the irrigated crops. Principal dry-farmed crops were orchard, grain hay, and vineyard. Other agricultural lands were used for dry pasture.

Present water supplies in the service area are furnished by the Pacific Gas and Electric Company, which develops water from the Yuba and Bear Rivers for use in its Bear River hydroelectric system and for irrigation and municipal use in Placer County.

SACRAMENTO COUNTY

Carson Service Area

Location and Physical Features. The Carson Service Area is located in northeast Sacramento County between the American and Cosumnes Rivers, and extends from the El Dorado county boundary to the proposed South Canal from Folsom Reservoir.

Mean seasonal depth of precipitation varies from 18 to 27 inches. Elevations range from 100 to 800 feet above sea level, with virtually all of the irrigable land situated below the 500-foot contour. The topography varies from flat to rolling, with typical hummocky terrain.

In the western half of the service area the soils are derived generally from old to recent alluvial deposits, the best types being located along the floodplains of the Cosumnes River and other local streams. The poorer types of soils are characterized by heavy texture, slow drainage, and hardpan at varying depths. The soil pattern in the east half of the service area is complex, including soils of the Auburn, Hugo, and Goldridge-Vallecitos series-groups in roughly equal portions.

The gross land area is about 84,000 acres, about 45 per cent of which is classified as irrigable. More than half the gross irrigable area is rated Class 5(P) land. About one-third of the irrigable land, however, is rated Class 3 or better. More than half the irrigable land is concentrated in the western part of the area along the route of the proposed Folsom South Canal. The better types of land are located in this zone. Irrigable lands in the eastern part of the service area are generally poor in quality, and they occur in scattered but fairly large parcels.

Present Development. The Carson Service Area is sparsely populated throughout. The principal town and business center is Folsom, which has a population of about 2,200.

A branch of the Southern Pacific Railroad from Sacramento to Placerville traverses the northern part of the service area. U. S. Highway 50 and secondary state and county roads provide adequate access to all parts of the area.

The land classification and land use survey conducted in 1950 showed a gross irrigable area of 38,300 acres, of which almost 3,800 acres were cultivated. Almost two-thirds of the cultivated area was irrigated. Virtually all of the irrigated land was located in the extreme southern part of the area along the Cosumnes River. About half the irrigated area was in field crops, with the remainder divided between pasture, orchard, and truck crops. The dry-farmed lands were devoted exclusively to grain hay. Noncultivated lands were used largely for dry pasture.

Water for the irrigated lands along the Cosumnes River is obtained in part by direct diversion from the river and in part by pumping from wells. The privately owned Natomas Ditch, diverting from the South Fork of the American River primarily for gold dredging purposes, supplies the town of Folsom and a small irrigated acreage along its route.

Laguna Service Area

Location and Physical Features. This service area is located in southeast Sacramento County between Dry Creek and the Cosumnes River, and extends from the route of the proposed South Canal from Folsom Reservoir east to the Amador county boundary.

Mean seasonal depth of precipitation varies from 17 to 20 inches. Elevations range from 100 to 500 feet above sea level, with the majority of the irrigable lands situated below the 300-foot contour. The topography is flat to rolling, with typical hummocky terrain.

In the western half of the service area the soils are derived generally from old to recent alluvial deposits, the better types being located along the floodplains of the Cosumnes River, Dry Creek, and other local streams. The poorer types of soils are characterized by heavy texture, slow drainage, and hardpan at varying depths. Soils of the Goldridge-Vallecitos series-groups cover the eastern half of the area.

The gross land area is about 87,000 acres, almost 56 per cent of which is classified as irrigable. Two-thirds of the irrigable land is rated Class 4(3) or 5(P). Virtually all of the remainder is rated Class 3 or better. The irrigable lands are well concentrated, particularly along the western boundary of the service area.

Present Development. The Laguna Service Area is thinly populated, with no communities of more than a few score inhabitants. The area is served by a branch of the Southern Pacific Railroad from Galt to Ione, and by secondary state and county roads.

The land classification and land use survey conducted in 1950 showed a gross irrigable area of 48,500 acres, of which 4,400 acres were cultivated, including about 900 acres under irrigation. Irrigated lands were devoted chiefly to field crops and pasture, and the dry-farmed lands were planted in grain hay. Other agricultural lands were used for dry pasture. The present water supply is furnished partially from the Cosumnes River, with the remainder furnished from ground water.

SAN JOAQUIN COUNTY

Arroya Seco Service Area

Location and Physical Features. The Arroyo Seco Service Area is located in the extreme northeast corner of San Joaquin County between the Mokelumne River and Dry Creek, and extends from the Amador county line on the east to the approximate limit of the valley floor lands presently irrigated by pumping from the ground water basin. At Dry Creek the western boundary of the area departs from the terminus of the proposed South Canal from Folsom Reservoir, and follows generally along Coyote Creek to the Mokelumne River.

Mean seasonal depth of precipitation varies from 16 to 18 inches. Elevations range from 100 to 350 feet above sea level. The terrain is flat to gently rolling throughout the area.

The majority of the soils in the service area are alluvial types. Soils of the Goldridge and Vallecitos series-groups occur in the extreme eastern portion.

The gross land area is about 28,000 acres, about 60 per cent of which is classified as irrigable. Approximately 57 per cent of the irrigable lands are of Classes 4(3) and 5(P). More than 70 per cent of the remainder are rated Class 3 or better. The majority of the irrigable lands are well concentrated in the western part of the service area, but to the east they thin out in occurrence, and become poorer except in the bottom land areas along Dry Creek and the Mokelumne River.

Present Development. The Arroyo Seco Service Area is thinly populated, with no towns of recordable size. The area is served by secondary state and county roads. A branch of the Southern Pacific Railroad from Lodi to Valley Springs passes through Lockeford and Clements, just outside of the south boundary of the area.

The land classification and land use survey conducted in 1949 listed a gross irrigable area of 16,600 acres, of which 5,370 acres were cultivated, including 560 acres under irrigation. Most of the irrigated lands were in pasture, and most of the dry-farmed lands were planted to grain hay. Other agricultural lands in use were devoted to dry pasture.

Presently irrigated lands in the service area obtain water by pumped diversion from the Mokelumne River, and by pumping from wells.

Bear Creek Service Area

Location and Physical Features. This service area is located in northeast San Joaquin County between the Mokelumne River on the north and the boundary of the Stockton and East San Joaquin Water Conservation District on the south. From the Calaveras county boundary on the east, the area extends west to an arbitrary line denoting the approximate limit of the valley floor lands which are being irrigated from a ground water basin. This arbitrary line is located from one to three miles east of the Northern San Joaquin Water Conservation District, and passes slightly east of Lockeford and Clements.

Mean seasonal depth of precipitation varies from 16 to 18 inches. Elevations range from 100 to 400 feet above sea level. The terrain is flat to slightly rolling, with sparse cover.

The majority of the soils in the service area are alluvial types. Soils of the Goldridge and Vallecitos series-groups occupy the northeastern and southeastern portions adjoining Calaveras County.

The gross land area is about 49,000 acres, 73 per cent of which is classified as irrigable. Almost half the irrigable lands are rated Class 4(3) or 5(P). Most of the remainder is classified as 4(2) land. Virtually all of the irrigable lands are concentrated in one continuous body, typical of valley floor areas.

Present Development. The Bear Creek Service Area is thinly populated, with no settlements of recordable size. Secondary state and county roads provide adequate access to all but the eastern portion of the area. A branch of the Southern Pacific Railroad from Lodi to Valley Springs traverses the northern edge of the area.

According to the land use and land classification survey conducted in 1949, the gross irrigable area is 35,800 acres, of which 11,300 acres were cultivated, including about 600 acres under irrigation. The irrigated lands were planted chiefly to pasture, and almost all of the dry-farmed lands were in grain hay. Other agricultural lands were used for stock grazing purposes.

The irrigated lands in the service area are supplied with water by pumped diversion from the Mokelumne and Calaveras Rivers, and by pumping from wells.

TUOLUMNE COUNTY

Blanchard Service Area

Location and Physical Features. The Blanchard Service Area is located in southwest Tuolumne County between the Mariposa county boundary and the Tuolumne River, and extends west from Moccasin Creek into Stanislaus County as far as a proposed foothill conduit line. In this part of Stanislaus County this conduit route is tentatively located from one to five miles west of the Tuolumne county line.

Mean seasonal depth of precipitation varies from 17 to 28 inches. Elevations range from 400 to 3,000 feet above sea level, with a majority of the irrigable lands situated below the 1,500-foot contour. The topography varies from gently to moderately rolling foothills in the lower portions, to rugged slopes in the higher portions where local streams are deeply entrenched.

Soils of the service area are all of the shallower phases of the Auburn and Hugo series-groups.

The gross land area is about 43,000 acres, of which 82 per cent is in Tuolumne County. About 11 per cent of the gross area is classified as irrigable, almost two-thirds of it being in Tuolumne County. Irrigable lands are generally poor, more than 50 per cent being described as Class 5(P), and most of the remainder as Class 4(2) or 4(3). The irrigable lands are widely dispersed in small parcels.

Present Development. The Blanchard Service Area is sparsely settled, with only one community of as many as 100 inhabitants. A secondary road from La Grange to Coulterville traverses the lower half of the area. The upper portion is reached by a single dirt road.

The gross irrigable area is 4,800 acres, and in 1948 less than 100 acres were cultivated, the principal use of the land being for cattle grazing. None of the cultivated lands were irrigated.

Groveland Service Area

Location and Physical Features. This service area is in southern Tuolumne County between the Tuolumne River and the Mariposa county boundary, and extends from the vicinity of Buck Meadows on the east to Mocassin Creek on the west.

Mean seasonal depth of precipitation varies from 26 to 41 inches. Elevations range from 1,000 to 4,000 feet above sea level, with most of the irrigable land situated between 2,500 and 3,000 feet in elevation. The topography is generally rolling to hilly, with fairly gentle slopes in the agricultural areas. Along the canyon of the Tuolumne River the topography is rugged to precipitous.

Virtually all of the soils in the service area belong to the Aiken series-group, but along the extreme western fringe there are narrow zones of the Auburn, Holland, Hugo, and Montara series-groups.

The gross land area is about 59,000 acres, of which less than 19 per cent is classified as irrigable. About two-thirds of the irrigable land is Class 4(3), and virtually all of the remainder is Class 4(2). Most of the irrigable lands are fairly well concentrated on the broad ridge area north of Groveland. Another substantial body of irrigable land is located just west of Smith Station.

Present Development. The present population of the Groveland Service Area is estimated to be about 1,000. The principal town and business center is Groveland, with about 350 inhabitants.

The recent abandonment of the Hetch Hetchy Railroad deprived the service area of potential rail transportation, leaving the Big Oak Flat Road to Yosemite National Park and secondary county roads as the only means of access.

The land classification and land use survey made in 1948 showed a gross irrigable area of 10,900 acres, with less than 700 acres cultivated and no lands under irrigation. A majority of the cultivated lands was in grain hay, and the remainder was in orchards.

Keystone Service Area

Location and Physical Features. The Keystone Service Area is located principally in western Tuolumne County between the Stanislaus and Tuolumne Rivers and west of the low divide forming the western boundary of the Woods Creek drainage basin. From that line which is also the lower boundary of the Phoenix Service Area, the service area extends west to a projected foothill conduit line in Stanislaus County a short distance west of the Tuolumne county line.

Mean seasonal depth of precipitation varies from 17 to 26 inches. Elevations range from 100 to 1,500 feet above sea level. The service area is characterized by gently rolling relief, with small alluvial plains along local creeks and large areas of open grasslands.

Arable soils in the service area are all of the shallower phases of the Auburn and Hugo series-groups. The largest single serpentinized intrusion in the Mother Lode Region is found in the Keystone Service Area, and extends northward across the adjoining Phoenix Service Area into Calaveras County, and southward to a small extent into the Blanchard Service Area. This zone of nonagricultural Montara soils occupies about 15 per cent of the service area.

The gross land area is about 85,000 acres, of which less than 15 per cent is classified as irrigable. More than 90 per cent of the gross area and 95 per cent of the irrigable land are in Tuolumne County. Irrigable lands are of fairly good quality, almost 55 per cent being Class 4(2) or better. About half the irrigable lands are located in a long continuous body extending from the vicinity of Curtin Ranch on State Route 13 to Don Pedro Reservoir on the Tuolumne River. The remainder of the irrigable lands are widely scattered throughout the service area.

Present Development. The Keystone Service Area is thinly populated. Chinese Camp, a community of about 300, is the only town of recordable size.

The area is served by a branch railroad from Stockton to Sonora, and by a good network of state and county roads.

The land classification and land use survey conducted in 1948 showed a little more than 300 acres of the gross irrigable area of 12,500 acres under cultivation, and only 40 acres irrigated. The irrigated lands were in orchard and pasture, and the remainder of the cultivated lands were planted to grain hay. Other irrigable lands were either idle or used for dry pasture.

With the exception of individual domestic and stock-watering wells, there has been no water supply development in the Keystone Service Area.

Lyons Service Area

Location and Physical Features. The Lyons Service Area is located in northwest Tuolumne County below the elevation of the Tuolumne Ditch and above Phoenix Reservoir. It extends from the Stanislaus River on the west to the North Fork of the Tuolumne River on the east.

Mean seasonal depth of precipitation varies from 31 to 42 inches. Elevations range from 2,500 to 5,000 feet above sea level. However, the irrigable lands are all below the 4,000-foot contour. The terrain may be described generally as mountainous, but many localities along local streams, on ridge crests, and on weathered granitic surfaces are characterized by gentle slopes favorable to irrigation development.

Soils in this service area are mainly of the Holland and Hugo series-groups, with small local areas of Aiken soils. The Holland soils predominate in the eastern portion, and the Hugo soils in the western part. In the latter are extensive areas of Calaveras limestone, especially in the vicinity of Columbia, from which the soil mantle has been largely removed by placer mining operations.

The gross land area is about 58,000 acres, of which approximately 11 per cent has been classified as irrigable land. Approximately 70 per cent of the irrigable land is Class 4(2) or better. The irrigable lands, however, are scattered.

Present Development. The population of the Lyons Service Area is estimated to be about 4,000, amounting to approximately one-third of the Tuolumne County total. The principal town is Tuolumne, with a population of about 1,550.

The area is served by state and county highways, and by a branch railroad which connects the town of Tuolumne with Sonora and Stockton.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 6,200 acres, of which 900 acres were under irrigation. The latter represents the most extensive irrigation development in Tuolumne County, and is attributable to the water supply furnished through the Tuolumne Ditch System. Deciduous fruits and irrigated pasture accounted for virtually all of the irrigated crops.

Irrigated lands and communities in the Lyons Service Area are served by the Tuolumne Ditch System of the Pacific Gas and Electric Company, which diverts water from the South Fork of the Stanislaus River at Lyons Dam. This system was originally constructed by mining interests, but gradually the type of use changed to domestic and irrigation service and to the development of hydroelectric energy. The community of Twain Harte has been organized as Tuolumne County Water District No. 1, and distributes water supplies obtained from the Tuolumne Ditch. Tuolumne County Water District No. 2 includes all other lands in the service area, as well as those in the adjacent Phoenix and Keystone Service Areas.

Phoenix Service Area

Location and Physical Features. The Phoenix Service Area is located in Tuolumne County between the Stanislaus and Tuolumne Rivers, and extends from the vicinity of Phoenix Reservoir on the north to the vicinity of Chinese Camp on the south.

Mean seasonal depth of precipitation varies from 21 to 41 inches. Elevations range from 1,000 to 2,500 feet above sea level. The topography is predominantly of the rolling foothill type, with scattered forest cover, and relatively gentle slopes.

Soils in the service area are highly variable, being composed of the Hugo-Auburn complex in the western portion, which also contains several areas of Montara soils. In the vicinity of Sonora and Standard, soils of the Holland series-group predominate. The remainder of the service area is composed largely of soils in the Hugo series-group.

The gross land area is about 83,000 acres, approximately 21 per cent of which is classified as irrigable. Slightly more than half the irrigable lands are classified as Class 4(2) or better, including over 2,200 acres of Class 2 land. The majority of the remainder is Class 4(3). The irrigable lands are not well concentrated, but they do occur in fairly large parcels.

Present Development. It is estimated that about half the 12,000 population of Tuolumne County lives in the Phoenix Service Area. The principal town and business center is Sonora, the county seat, with a present population of about 2,500. Other important centers are Jamestown and Standard, with populations of about 850 and 550, respectively. Transportation facilities include a branch railroad from Stockton, and a good network of state and county roads.

The land classification and land use survey conducted in 1948 listed a gross irrigable area of 17,800 acres, of which 1,750 acres were cultivated, including 420 acres under irrigation. The remainder of the irrigable lands were used for dry pasture or were not used at all. Principal crops were grain, hay, deciduous fruits, and irrigated pasture.

Irrigation and municipal water supplies for the Phoenix Service Area are furnished from Phoenix Reservoir of the Pacific Gas and Electric Company. Located on Sullivan Creek, the reservoir has a storage capacity of 850 acre-feet. Water diverted from Lyons Reservoir on the South Fork of the Stanislaus River reaches Phoenix Reservoir by means of the Tuolumne Canal, passing through the Phoenix Power Plant of the Pacific Gas and Electric Company.

YUBA COUNTY

Browns Valley Service Area

Location and Physical Features. This service area is located in Yuba County between South Honcut Creek and the Yuba River, and extends from the existing main canal of the Browns Valley Irrigation District southwest to the location of a possible foothill canal from the proposed Oroville Reservoir on the Feather River. This projected conduit line coincides very nearly with the lower boundary of the Browns Valley Irrigation District.

Mean seasonal depth of precipitation varies from 24 to 40 inches. Elevations range from 100 to 1,200 feet above sea level, with the majority of the irrigable lands situated below the 600-foot contour. The topography is generally flat to rolling, with sparse cover.

The majority of the soils in the service area belong to the Auburn series-group. Soils of the Holland series-group occur in limited zones in the extreme east portion. Soils of alluvial origin occupy the extreme western portion.

The gross land area is about 49,000 acres, almost 37 per cent of which is classified as irrigable. More than 70 per cent of the gross irrigable area is rated Class 4(3) or 5(P) land, and about 20 per cent is described as Class 2 or 3 land. Most of the better lands are located in the extreme western part of the service area and are well concentrated. In other parts of the area the irrigable lands are somewhat scattered, except in the region northwest of Lafferty Peak, where there is a large contiguous body of Classes 4(3) and 5(P) land.

Present Development. The Browns Valley Service Area is a thinly populated rural district with no towns of significance. Loma Rica and Browns Valley are communities of 150 or so inhabitants. The area is served by an adequate network of secondary state and county roads.

The land use and land classification survey conducted in 1948 showed a gross irrigable area of 17,900 acres, of which 4,400 acres were cultivated, including more than 3,600 acres under irrigation. About 85 per cent of the irrigated land was in pasture, and most of the remainder was in olive orchards. Virtually all of the dry-farmed lands were producing grain hay. Most of the noncultivated lands were used for dry pasture.

Present water supplies in the service area are furnished by the Browns Valley Irrigation District, which obtains water from the North Fork of the Yuba River. The district diverts at a maximum rate of 472 second-feet from the forebay of the Colgate Power Plant of the Pacific Gas and Electric Company. The present water supply is not sufficient to support further expansion of agriculture in the service area.

Challenge Service Area

Location and Physical Features. The Challenge Service Area is located in northeast Yuba County between the North Fork of the Yuba River and the Butte county boundary, and extends from the Browns Valley Irrigation District northeast to Woodville Creek.

Mean seasonal depth of precipitation varies from 29 to 71 inches. Elevations range from 600 to 4,000 feet above sea level. The topography is generally hilly to mountainous, but slopes in valley areas, particularly in the vicinity of Oregon House and Challenge, are moderate.

Soils of the Auburn, Holland, and Aiken series-groups occur in the service area. Soils of the Auburn and Aiken series-groups predominate in the southwest and northeast portions, while alternate zones of Holland and Aiken soils cover the central part.

The gross land area is about 103,000 acres, 24 per cent of which is classified as irrigable. The irrigable lands are of fair quality, almost 47 per cent being rated Class 4(2) or better. Most of the remainder is rated Class 4(3). The irrigable lands occur in large, fairly well concentrated groups, separated by large areas of nonagricultural land. The principal groups of irrigable lands are in the vicinity of Challenge and in the Oregon House-Dobbins region.

Present Development. The population of the Challenge Service Area is small and scattered. There are several small towns, the largest of which is Challenge, a community of about 300 inhabitants. Adequate access to all parts of the area is provided by a network of secondary state and county roads.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 25,000 acres, of which some 900 acres were cultivated. More than 87 per cent of the cultivated land was under irrigation, the principal crops being pasture and orchards. All of the irrigated lands are located in the extreme southwest part of the service area, between Stanfield Hill and Tennessee Creek.

Present irrigation supplies in the service area are furnished from the privately owned Los Verjels Reservoir, located on Dry Creek a few miles above Virginia Ranch.

Smartville Service Area

Location and Physical Features. This service area is located in Yuba County between the Yuba and Bear Rivers, and extends west from the Nevada county line to the location of a possible foothill conduit from the proposed Narrows Reservoir on the Yuba River. This conduit route follows the 500-foot contour from the Narrows Reservoir to the proposed Waldo Reservoir on Dry Creek, from where it follows the 220-foot contour south to the Bear River. The conduit line is within four miles of the Nevada county boundary all along its route from the Yuba to the Bear River.

Mean seasonal depth of precipitation varies from 24 to 29 inches. Elevations range from 220 to 1,300 feet above sea level. The terrain is rolling to hilly, with sparse cover.

Soils of the Auburn series-group cover all of the service area, with the exceptions of very limited zones of alluvial soils in the north and of Holland soils in the south.

The gross land area is about 19,000 acres, 33 per cent of which is classified as irrigable. The irrigable lands are generally poor, more than 87 per cent being rated Class 4(3) or 5(P). In their occurrence the irrigable lands are scattered and dispersed, except in the vicinity of Vineyard Creek where more than one-third of the irrigable lands is located.

Present Development. The population of the Smartville Service Area is small and scattered. The only town is Smartville, a community of about 200 inhabitants. Adequate access to all parts of the service area is provided by a network of secondary roads.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 6,300 acres, more than 90 per cent of which is within the boundaries of the Camp Beale Military Reservation. About 250 acres were irrigated, all in pasture and all located in the extreme northern part of the service area outside the boundaries of Camp Beale. None of the irrigable lands inside Camp Beale are cultivated now, and it is possible that, due to military restrictions, none will ever be cultivated.

The irrigated lands in the northern part of the service area receive water from the China Ditch of the Nevada Irrigation District. The ditch diverts from Deer Creek a few miles above its mouth.

Strawberry Service Area

Location and Physical Features. The Strawberry Service Area is located in northeast Yuba County between the North Fork of the Yuba River and the Butte county line, and extends from Woodville Creek to the vicinity of Strawberry Valley.

Mean seasonal depth of precipitation is extremely high, being in excess of 70 inches over most of the area. Elevations range from 2,000 to 4,000 feet above sea level, with virtually all of the irrigable lands situated above the 3,000-foot contour. The service area has a complex pattern of soils of the Aiken, Holland, and Montara series-groups.

The topography is rugged along the deep canyon of the North Fork of the Yuba River, but atop the ridge between that stream and the South Fork of the Feather River the slopes are moderate. Most of the service area is covered by heavy stands of timber.

The gross land area is about 17,000 acres, almost 19 per cent of which is classified as irrigable. The irrigable lands are well concentrated in occurrence, but poor in quality, almost 80 per cent being rated Class 4(3).

Present Development. The Strawberry Service Area is sparsely populated, with no towns of more than a few score inhabitants. Access to the area is provided by secondary roads, many of which are in poor condition.

The land classification and land use survey conducted in 1948 showed a gross irrigable area of 3,200 acres, less than 100 acres of which were cultivated, all in nonirrigated orchards.

APPENDIX B

PRECIPITATION STATIONS AND STREAM GAGING STATIONS IN OR ADJACENT TO THE MOTHER LODE REGION

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PRECIPITATION STATIONS AND STREAM GAGING STATIONS IN OR ADJACENT TO THE MOTHER LODE REGION

TABLE 1

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude: Degree	Latitude and longitude: Minute	Elevation, in feet	Period of record	Source of record*	Precipitation: Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum: Season	Maximum and minimum: Inches of depth
	Alpine County								
5-124	Twin Lakes	38 120	42 03	7,920	1919–20 1951–52	PGE USWB	45.80	1937–38 1923–24	74.82 23.39
5-137	Tamarack	38 119	37 57	8,000	1900–01 1947–48	USWB	47.33	1906–07 1925–26	93.99 23.50
6-9	Markleeville	38 119	41 47	5,526	1909–10 1950–51	USWB	20.06	1913–14 1923–24	32.10 9.99
	Amador County								
5-142	Drytown	38 120	27 51	790	1891–92 1905–06	USWB	22.80	1894–95 1897–98	39.94 16.35
5-143	Kennedy Mine	38 120	21 46	1,500	1892–93 1946–47	USWB	28.15	1894–95 1923–24	54.07 13.26
5-144	Jackson	38 120	24 43	1,900	1893–94 1902–03	USWB	25.11	1894–95 1897–98	50.10 19.53
5-145	Electra	38 120	20 40	699	1904–05 1951–52	USWB	31.45	1906–07 1923–24	50.97 15.04
5-147	Mill Creek No. 1	38 120	27 30	2,400	1907–08 1930–31	USWB	47.00	1910–11 1923–24	66.37 19.79
5-148	Tiger Creek	38 120	27 29	2,341	1931–32 1951–52	USWB	46.91	1950–51 1932–33	69.03 28.41
	Butte County								
5-27	Inskip	40 121	00 32	4,818	1907–08 1947–48	USWB	71.92	1937–38 1923–24	124.11 32.36
5-33	West Branch	39 121	59 39	3,216	1907–08 1951–52	USWB	68.03	1908–09 1923–24	115.35 33.13
5-34	De Sabla	39 121	52 35	2,700	1904–05 1951–52	USWB	59.59	1940–41 1923–24	99.06 26.84
5-35	Stirling City	39 121	54 31	3,525	1903–04 1945–46	USWB	65.44	1906–07 1917–18	125.20 36.76
5-45	Phelan Parrot	39 121	45 58	130	1924–25 1949–50	Private	20.49	1937–38 1949–50	34.93 12.92
5-46	Chico	39 121	42 49	189	1871–72 1951–52	USWB	25.13	1940–41 1887–88	45.79 12.97
5-47	Centerville Power House	39 121	47 40	490	1914–15 1951–52	USWB	40.46	1940–41 1923–24	70.79 20.54
5-48	Magalia	39 121	47 35	2,321	1904–05 1917–18	USWB	78.10	1908–09 1917–18	122.51 37.11
5-50	Las Plumas	39 121	40 29	569	1914–15 1951–52	USWB	45.89	1940–41 1922–24	77.50 20.72
5-51	Intake	39 121	43 28	920	1921–22 1937–38	PGE	50.46	1937–38 1923–24	74.33 23.13
5-52	Stanwood	39 121	43 23	2,140	1903–04 1919–20	USWB	63.30	1906–07 1911–12	97.78 32.32
5-52A	Brush Creek Ranger Station	39 121	41 20	3,500	1935–36 1940–41 1938–39 1951–52	USWB	65.92	1937–38 1948–49	109.06 50.73
5-59	Llano Seco Rancho	39 121	36 57	206	1917–18 1947–48	Private	18.96	1940–41 1923–24	37.53 9.94
5-60	Durham	39 121	38 48	160	1895–96 1919–20	USWB	24.70	1913–14 1911–12	35.44 15.30
5-61	Oroville (River station)	39 121	32 34	273	1908–09 1951–52	USWB	27.16	1951–52 1911–12	43.94 14.31

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude		Elevation, in feet	Period of record	Source of record*	Precipitation		
							Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum	
		Degree	Minute					Season	Inches of depth
	Butte County—Continued								
5-62	Oroville	39 121	31 33	250	1884–85 1951–52	USWB	27.27	1889–90 1930–31	49.64 14.71
5-62A	Oroville (near)	39 121	31 34	400	1940–41 1951–52	SDF	25.26	1940–41 1945–46	40.72 19.30
5-63	Forbestown	39 121	32 17	2,800	1920–21 1937–38	Private	65.38	1937–38 1923–24	105.35 29.67
5-69	Biggs	39 121	25 43	98	1899–00 1915–16	USWB	21.04	1913–14 1911–12	21.20 12.29
5-70	Gridley	39 121	22 42	97	1884–85 1951–52	USWB	24.00	1889–90 1897–98	47.00 12.34
5-71	Palermo	39 121	26 33	213	1891–92 1913–14	USWB	23.29	1904–05 1897–98	32.77 10.94
5-72	Serriterre	39 121	25 28	629	1920–21 1948–49	USWB	29.76	1940–41 1923–24	44.08 15.79
	Calaveras County								
5-146	West Point	38 120	25 32	2,736	1894–95 1951–52	USWB	38.73	1894–95 1923–24	59.91 16.84
5-153	Wallace	38 120	11 58	200	1926–27 1951–52	USWB	18.93	1935–36 1930–31	27.30 10.32
5-154	Camp Pardee	38 120	14 50	658	1929–30 1951–52	EBMUD USWB	20.24	1935–36 1932–33	29.97 12.67
5-155	Lancha Plana	38 120	15 51	670	1926–27 1939–40	USWB	20.87	1935–36 1932–33	29.92 12.72
5-156	Valley Springs	38 120	11 50	673	1888–89 1937–38	USWB	21.55	1889–90 1923–24	38.15 10.08
5-157	Mokelumne Hill	38 120	18 42	1,550	1882–83 1946–47	USWB	29.75	1889–90 1923–24	54.59 13.33
5-158	San Andreas	38 120	11 41	996	1924–25 1950–51	USWB	26.76	1935–36 1923–24	38.76 15.68
5-159	Fricot City	38 120	11 32	1,900	1918–19 1937–38	USWB	28.85	1937–38 1923–24	41.41 14.64
5-160	Letora Ranch	38 120	12 28	1,600	1927–28 1940–41	Private	34.21	1937–38 1930–31	53.76 19.28
5-161	Calaveras Big Trees	38 120	17 18	4,702	1929–30 1951–52	Private	54.05	1937–38 1930–31	77.02 33.06
5-172	Jenny Lind	38 120	06 52	300	1907–08 1946–47	USWB	19.31	1935–36 1923–24	28.87 8.81
5-173	Milton	38 120	02 51	660	1888–89 1951–52	USWB	20.02	1894–95 1923–24	32.31 10.47
5-174	Angels Camp No. 2	38 120	04 32	1,500	1908–09 1951–52	USWB	30.96	1910–11 1923–24	50.35 12.86
5-175	Murphys	38 120	08 28	2,201	1868–69 1883–84	Private	30.10	1875–76 1876–77	44.76 15.18
	El Dorado County								
5-110	Georgetown	38 120	55 50	2,060	1872–73 1951–52	USWB	50.97	1889–90 1938–39	95.27 29.62
5-111	Pilot Creek	38 120	55 41	4,000	1894–95 1913–14	USWB	64.87	1903–04 1897–98	95.54 37.46
5-122	Shingle Springs	38 120	40 56	1,415	1849–50 1911–12	USWB	30.04	1861–62 1897–98	79.24 14.60

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude		Elevation, in feet	Period of record	Source of record*	Precipitation		
							Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum	
		Degree	Minute					Season	Inches of depth
	El Dorado County—Continued								
5-123	Placerville	38 120	43 47	1,925	1874–75 1951–52	USWB	38.55	1889–90 1923–24	78.23 20.13
	Glenn County								
5-43	Saint John	39 122	42 01	143	1912–13 1951–52	USWB	20.68	1940–41 1923–24	40.60 9.42
5-44	Hamilton City	39 122	45 00	162	1927–28 1951–52	USWB	18.81	1941–42 1932–33	28.12 9.47
5-58	Monroeville	39 122	38 00	130	1908–09 1926–27	USWB	17.14	1913–14 1923–24	29.92 9.33
	Lassen County								
5-23	Westwood	40 121	18 00	5,080	1921–22 1951–52	USWB	24.25	1937–38 1938–39	35.36 11.54
6-4	Susanville	40 120	25 39	4,271	1889–90 1951–52	USWB	17.06	1889–90 1949–50	36.26 8.22
	Madera County								
5-219	Chowchilla	37 120	05 27	150	1887–88 1937–38	Private	9.84	1889–90 1923–24	16.11 4.23
	Mariposa County								
5-191	Dudleys	37 120	45 06	3,000	1909–10 1951–52	USWB	36.63	1910–11 1923–24	57.18 18.41
5-193	Yosemite	37 119	45 35	3,985	1904–05 1951–52	USWB	33.97	1937–38 1923–24	58.64 14.77
5-203	Hornitos	37 120	30 14	950	1923–24 1951–52	Private	17.75	1934–35 1923–24	26.98 9.25
5-204	Mariposa	37 119	30 58	1,800	1894–95 1951–52	USWB	29.06	1910–11 1923–24	46.81 12.90
5-209	Summerdale	37 119	29 38	5,270	1896–97 1911–12	USWB	56.70	1900–01 1897–98	85.46 29.34
	Merced County								
5-201	Snelling	37 120	31 26	259	1882–83 1937–38	Private	14.62	1889–90 1912–13	29.99 7.27
5-202	Merced Falls	37 120	32 20	351	1907–08 1949–50	USWB	15.16	1934–35 1923–24	22.45 8.20
5-208	Livingston	37 120	23 43	130	1918–19 1937–38	Private	10.94	1937–38 1923–24	18.10 5.00
5-211	Merced	37 120	19 29	170	1872–73 1951–52	USWB	11.68	1883–84 1876–77	22.08 3.20
5-212	Althone	37 120	12 21	205	1886–87 1896–97	USWB	12.74	1889–90 1887–88	19.07 6.81
5-213	La Grande	37 120	14 14	255	1899–00 1951–52	USWB	12.43	1940–41 1907–08	20.81 4.87
	Mono County								
6-10	Shields Ranch	38 119	32 28	5,300	1910–11 1945–46	USWB	11.25	1931–32 1927–28	19.08 6.61
6-14	Ellery Lake	37 119	56 14	9,600	1925–26 1951–52	USWB	31.69	1926–27 1948–49	40.83 12.32
	Nevada County								
5-77	North Bloomfield	39 120	22 54	3,160	1870–71 1943–44	USWB	51.11	1906–07 1923–24	77.84 21.47
5-78	Bowman Dam	39 120	27 39	5,347	1871–72 1951–52	USWB	66.50	1903–04 1887–88	142.07 29.40
5-79	Lake Spaulding	39 120	20 39	5,075	1894–95 1951–52	USWB	65.31	1903–04 1923–24	102.56 34.39

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude		Elevation, in feet	Period of record	Source of record*	Precipitation		
							Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum	
		Degree	Minute					Season	Inches of depth
	Nevada County—Continued								
5-80	Fordyce Dam	39	23	6,500	1894–95	USWB	64.47	1894–95	116.52
		120	30		1928–29			1923–24	35.78
5-83	Grass Valley	39	13	2,690	1872–73	USWB	52.62	1889–90	89.82
		121	03		1951–52			1923–24	24.55
5-84	Nevada City	39	16	2,570	1863–64	USWB	48.74	1867–68	115.26
		121	01		1951–52			1863–64	17.28
5-86	Deer Creek	39	18	3,700	1907–08	USWB	67.46	1937–38	103.98
		120	50		1951–52			1923–24	28.89
5-92	Soda Springs	39	19	6,752	1930–31	USWB	48.96	1951–52	80.73
		120	23		1951–52			1930–31	26.23
6-6	Truckee	39	20	5,819	1870–71	USWB	25.39	1889–90	54.84
		120	11		1951–52			1887–88	9.35
6-7	Boca	39	23	5,535	1870–71	USWB	19.88	1889–90	52.15
		120	06		1951–52			1876–77	7.60
	Placer County								
5-85	Gold Run	39	10	3,222	1899–00	USWB	48.65	1903–04	77.55
		120	53		1918–19			1907–08	28.06
5-87	Towle	39	12	3,704	1889–90	USWB	59.12	1913–14	85.86
		120	48		1919–20			1897–98	33.29
5-88	Drum Forebay	39	16	4,563	1916–17	PGE	55.56	1937–38	90.86
		120	46		1939–40			1923–24	25.56
5-89	Blue Canyon	39	17	5,283	1899–00	USWB	57.60	1951–52	101.67
		120	42		1951–52			1923–24	28.04
5-90	Emigrant Gap	39	18	5,220	1870–71	USWB	52.52	1906–07	94.30
		120	39		1944–45			1874–75	17.35
5-91	Cisco	39	18	5,939	1870–71	USWB	47.22	1889–90	97.63
		120	33		1915–16			1874–75	28.19
5-93	Summit	39	19	7,017	1871–72	USWB	45.36	1879–80	80.10
		120	20		1925–26			1923–24	20.76
5-99	Colfax	39	06	2,421	1870–71	USWB	46.22	1889–90	89.80
		120	58		1951–52			1923–24	20.44
5-100	Iowa Hill	39	05	2,825	1879–80	USWB	48.93	1889–90	91.04
		120	50		1909–10			1897–98	29.47
5-108	Newcastle	38	52	970	1891–92	USWB	28.38	1906–07	48.05
		121	08		1938–39			1938–39	16.63
5-109	Auburn	38	55	1,363	1871–72	USWB	33.12	1906–07	56.73
		121	05		1951–52			1911–12	12.63
5-119	Roseville High School	38	45	160	1926–27	Private	17.12	1951–52	25.34
		121	17		1951–52			1938–39	10.78
5-120	Rocklin	38	48	239	1870–71	USWB	23.14	1906–07	38.63
		121	15		1951–52			1923–24	10.42
6-8	Tahoe	39	10	6,330	1910–11	USWB	30.60	1951–52	54.87
		120	10		1951–52			1923–24	14.18
	Plumas County								
5-20	Chester	40	19	4,550	1910–11	USWB	28.73	1940–41	48.91
		121	13		1951–52			1923–24	12.98
5-21	Canyon Dam	40	11	4,570	1907–08	USWB	36.14	1937–38	64.59
		121	12		1951–52			1923–24	14.52

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude		Elevation, in feet	Period of record	Source of record*	Precipitation		
							Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum	
		Degree	Minute					Season	Inches of depth
	Plumas County—Continued								
5-22	Prattville	40 121	13 10	4,600	1923–24 1951–52	PGE	36.23	1937–38 1923–24	59.71 14.24
5-28	Caribou	40 121	05 09	3,000	1922–23 1951–52	PGE	40.26	1937–38 1923–24	66.84 14.55
5-29	Greenville	40 120	08 57	3,600	1894–95 1951–52	USWB	37.77	1906–07 1911–12	67.34 22.61
5-30	Veramont	40 120	06 50	3,500	1920–21 1951–52	PGE	33.01	1937–38 1923–24	52.43 14.54
5-36	Storrie	39 121	54 20	1,760	1929–30 1951–52	PGE	63.93	1937–38 1938–39	103.02 36.65
5-37	Bucks Lake	39 121	54 12	5,000	1930–31 1951–52	PGE	69.57	1951–52 1930–31	108.84 28.36
5-38	Edmonton	39 121	54 06	4,750	1877–78 1904–05	USWB	74.12	1889–90 1897–98	139.15 42.04
5-39	Feather River	39 120	58 56	3,480	1913–14 1937–38	Private	32.67	1913–14 1930–31	50.96 15.76
5-40	Feather River (California Forestry)	39 120	58 56	3,480	1913–14 1951–52	F&RESB	32.94	1913–14 1930–31	50.96 15.76
5-41	Quincy	39 120	56 55	3,409	1895–96 1951–52	USWB	39.22	1906–07 1911–12	73.22 20.25
5-53	La Porte	39 120	41 59	5,000	1894–95 1932–33	USWB	72.68	1910–11 1923–24	165.05 29.52
5-54	Portola	39 120	48 28	5,000	1915–16 1951–52	USWB	18.02	1951–52 1923–24	36.10 6.17
5-54A	Vinton	39 120	48 11	5,000	1941–42 1951–52	DWR	10.79	1950–51 1948–49	19.31 9.45
	Sacramento County								
5-121	Represa	38 121	41 10	305	1893–94 1944–45	USWB	23.94	1906–07 1923–24	43.12 11.54
5-132	Brighton	38 121	33 26	53	1877–78 1898–99	USWB	13.48	1889–90 1881–82	28.44 9.22
5-133	Florin	38 121	30 24	42	1925–26 1949–50	Private	16.71	1940–41 1938–39	26.92 9.99
5-134	Folsom	38 121	39 10	252	1871–72 1951–52	USWB	23.70	1889–90 1876–77	43.31 10.19
5-150	Galt	38 121	15 18	49	1878–79 1932–33	USWB	17.65	1889–90 1923–24	33.60 8.75
	San Joaquin County								
5-151	Elliot	38 121	15 12	85	1926–27 1951–52	USWB	16.65	1940–41 1930–31	23.76 10.06
5-152	Lockeford	38 121	10 09	106	1926–27 1951–52	Private	16.24	1936–37 1930–31	23.04 9.96
5-171	Bellota	38 121	03 00	130	1911–12 1928–29	USWB	18.59	1913–14 1923–24	25.02 9.57
5-177	Farmington	37 120	55 59	111	1877–78 1951–52	USWB	15.21	1889–90 1911–12	24.83 7.93
	Sierra County								
5-64	Downieville	39 120	34 50	2,460	1908–09 1951–52	USWB	60.30	1951–52 1923–24	89.84 25.78
5-65	Sierraville	39 120	35 22	4,975	1909–10 1951–52	USWB	24.23	1913–14 1923–24	43.80 8.23

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude: Degree	Latitude and longitude: Minute	Elevation, in feet	Period of record	Source of record*	Precipitation: Mean seasonal, 1897-1947, in inches of depth	Precipitation: Maximum and minimum: Season	Precipitation: Maximum and minimum: Inches of depth
	Stanislaus County								
5-178	Oakdale	37 120	51 53	215	1880–81 1942–43	USWB	13.86	1906–07 1912–13	22.62 6.42
5-196	Denair	37 120	33 47	126	1899–00 1951–52	USWB	10.79	1937–38 1916–17	18.66 4.80
5-197	Waterford	37 120	38 45	160	1903–04 1928–29	Private	14.03	1906–07 1923–24	18.92 4.91
5-198	Hickman	37 121	33 45	165	1914–15 1925–26	MID	12.27	1921–22 1923–24	16.58 5.12
5-199	Montpellier	37 120	33 42	225	1903–04 1926–27	Private	13.66	1905–06 1923–24	18.95 5.49
5-200	La Grange	37 120	39 28	298	1868–69 1931–32	USWB	17.10	1889–90 1876–77	30.34 5.74
5-207	Turlock	37 120	29 49	105	1893–94 1943–44	USWB	11.83	1906–07 1897–98	17.38 5.38
	Sutter County								
5-107	Nicolaus	38 121	54 35	46	1912–13 1951–52	USWB	18.32	1940–41 1912–13	32.46 7.07
	Tehama County								
5-25	Tehama	40 121	02 08	220	1871–72 1915–16	USWB	19.21	1892–93 1874–75	51.98 5.95
5-26	Los Molinos	40 122	01 06	215	1924–25 1945–46	Private	22.07	1937–38 1932–33	31.83 12.52
5-31	Corning Observer	39 122	50 08	275	1880–81 1951–52	Private	20.18	1940–41 1949–50	46.34 7.70
5-32	Vina-Stanford	39 122	56 03	150	1916–17 1944–45	Private	22.83	1940–41 1923–24	46.80 9.84
	Tuolumne County								
5-162	Sand Bar	38 120	11 09	2,700	1922–23 1908–09	PGE	41.28	1937–38 1923–24	65.00 17.93
5-163	Spring Gap	38 120	11 06	4,875	1922–23 1939–40	PGE	44.48	1939–40 1923–24	76.88 22.39
5-164	Strawberry Dam	38 119	11 59	5,620	1922–23 1951–52	PGE	39.19	1937–38 1923–24	70.42 17.94
5-179	Melones	37 120	58 31	741	1907–08 1926–27	USWB	29.42	1908–09 1923–24	43.57 13.06
5-180	Jamestown	37 120	57 55	1,471	1903–04 1914–15	USWB	30.16	1937–38 1912–13	64.61 17.49
5-181	Sonora	37 120	58 24	1,825	1887–88 1951–52	USWB	32.00	1889–90 1923–24	67.39 13.67
5-182	Jacksonville	37 120	51 22	700	1907–08 1916–17	USWB	26.47	1910–11 1907–08	37.49 15.31
5-183	Groveland	37 120	50 13	1,400	1929–30 1944–45	USWB	35.65	1937–38 1930–31	57.23 20.76
5-184	Early Intake	37 119	52 58	2,356	1925–26 1951–52	SFPUC	33.65	1937–38 1930–31	52.39 21.09
5-185	Lake Eleanor	37 119	57 53	4,650	1910–11 1951–52	USWB	42.99	1937–38 1923–24	64.61 20.83
5-186	Hetch Hetchy	37 119	56 47	4,050	1911–12 1951–52	USWB	34.93	1937–38 1923–24	55.62 17.03

TABLE 1—Continued

PRECIPITATION STATIONS IN OR ADJACENT TO MOTHER LODE REGION WITH CONTINUOUS RECORDS OF 10 YEARS OR LONGER

Map reference number	County and station	Latitude and longitude		Elevation, in feet	Period of record	Source of record*	Precipitation		
							Mean seasonal, 1897-1947, in inches of depth	Maximum and minimum	
		Degree	Minute					Season	Inches of depth
	Tuolumne County—Continued								
5-189	Moccasin	37 120	49 18	950	1935-36 1951-52	SFPUC	26.65	1937-38 1946-47	41.20 18.71
5-190	Priest	37 120	49 16	2,245	1928-29 1951-52	SFPUC	26.70	1937-38 1930-31	40.25 16.57
5-192	Crockers	37 119	48 54	4,452	1896-97 1909-10	USWB	49.27	1905-06 1897-98	83.54 31.37
	Yuba County								
5-73	Colgate	39 121	20 11	584	1907-08 1951-52	USWB	39.92	1951-52 1923-24	56.99 18.51
5-74	Dobbins	39 121	22 10	1,650	1904-05 1945-46	USWB	41.03	1906-07 1923-24	64.28 20.13
5-75	Chute Camp	39 121	24 09	1,250	1907-08 1939-40	USWB	54.74	1937-38 1923-24	78.17 23.87
5-76	Camptonville	39 121	27 03	2,850	1907-08 1951-52	USWB	64.17	1908-09 1923-24	108.30 30.13
5-97	Marysville	39 121	08 24	61	1871-72 1951-52	USWB	20.68	1889-90 1884-85	38.91 8.15
5-98	Wheatland	39 121	01 25	84	1887-88 1944-45	USWB	20.84	1889-90 1887-88	33.69 11.07

* DWR Division of Water Resources.
F&RESB Forest and Range Experiment Station, Berkeley.
MID Modesto Irrigation District.
PGE Pacific Gas and Electric Company.
SFPUC San Francisco Public Utilities Commission.
SDF Division of Forestry.
USWB United States Weather Bureau.
EBMUD East Bay Municipal Utility District.

TABLE 2

STREAM GAGING STATIONS IN OR ADJACENT TO MOTHER LODE REGION

Map reference number	Stream and location of gaging station	Drainage area, in square miles	Period of record	Source of record*
	Sacramento River Basin			
5-97	Mill Creek near Los Molinos	134	1909–13, 1928–52	USGS
5-100	Deer Creek at Deer Creek Meadows		1928–32	USGS
5-101	Deer Creek at Polk Springs		1928–31	USGS
5-102	Deer Creek near Vina	200	1911–15, 1920–37, 1939–52	USGS
5-105	Chico Creek near Chico	68	1930–52	USGS
5-122	Butte Creek near Chico	148	1930–52	USGS
5-243A	Coon Creek at Highway 99E	84	1947–52	DWR
5-243B	Auburn Ravine at Highway 99E	32	1950–52	DWR
5-243C	Pleasant Grove Creek at Lincoln Road	13	1950–52	DWR
	Feather River Basin			
5-143	Mountain Meadows Reservoir near Prattville		1931–52	PGE
5-144	Feather River, North Fork, above Prattville		1905–07	USGS
5-145	Feather River, North Fork, below Prattville	507	1905–52	USGS
5-146	Hamilton Branch near Prattville		1905–07	USGS
5-147	Almanor-Butt Creek Tunnel near Prattville		1940–46	USGS
5-148	Butt Creek above Almanor-Butt Tunnel	64	1936–52	USGS
5-149	Butt Creek below Almanor-Butt Tunnel	67	1938–52	USGS
5-150	Caribou Penstock Butt Valley Reservoir		1939	PGE
5-151	Butt Creek at Butt Valley		1905–21	USGS
5-152	Butt Creek near Caribou		1937–52	PGE
5-153	Indian Creek near Crescent Mills	746	1906–09, 1911–18, 1930–52	USGS
5-154	Spanish Creek at Keddie	184	1911–52	USGS
5-154A	East Branch, North Fork, near Rich Bar	1,035	1950–52	USGS
5-155	Grizzly Forebay near Storrie		1930–52	PGE
5-156	Bucks Creek Reservoir near Bucks Ranch	28	1928–52	USGS
5-157	Grizzly Creek at Diversion Dam		1932–38, 1940–52	USGS
5-158	Three Lakes near Bucks Ranch		1930–52	PGE
5-159	Bucks Creek Power House at Storrie		1935–39	
5-160	Grizzly Creek near Storrie	5	1929–32, 1933–44	USGS
5-161	Bucks Creek Tunnel at outlet		1934–36, 1937–52	USGS
5-162	Feather River, North Fork, at Big Bar	1,945	1911–30, 1932–37, 1939–52	USGS
5-163	Wilenor Canal near Yankee Hill		1929–52	PGE
5-164	Feather River, North Fork, at Big Bend		1905–10	USGS
5-165	Hendricks Canal near Nimshew		1936–52	PGE
5-166	Miocene Canal BW24 at head		1929–52	PGE
5-167	Miocene Canal BW26 near Yankee Hill		1930	PGE
5-168	Concow Creek near Yankee Hill	15	1927–52	USGS
5-169	Spring Valley Ditch near Yankee Hill		1927–52	USGS
5-170	Feather River, West Branch, near Yankee Hill	145	1930–52	USGS
5-172	Smith Neck Creek at Bear Valley Road crossing	34	1937–48	DWRWA
5-173	Smith Neck Creek at Loyalton	52	1937–52	DWRWA
5-174	Little Truckee Ditch at Summit		1937–52	DWRWA
5-175	Webber Creek near Sierraville	13	1937–52	DWRWA
5-176	Hamlin Creek near Sierraville	11	1937–43	DWRWA
5-177	Miller Creek near Sierraville	9	1937–52	DWRWA
5-178	Grizzly Creek near Portola	45	1925–32, 1950–52	USGS
5-179	Grizzly Creek near Beckwith		1906	USGS
5-180	Feather River, Middle Fork, near Clio	699	1925–52	USGS
5-181	Feather River, Middle Fork, near Sloat		1910–28	USGS
	Feather River Basin—Continued			
5-182	Feather River, Middle Fork, below Sloat	835	1940–52	USGS
5-183	Feather River, Middle Fork, near Nelson Point	898	1923–32	USGS
5-183A	Feather River, Middle Fork, near Merrimac	1,078	1951–52	USGS
5-184	Feather River, South Fork, near La Porte		1927–33	USGS
5-185	Lost Creek below Lost Creek Dam		1947–52	USBR
5-186	Lost Creek near Clipper Mills	30	1927–41, 1948–52	USGS
5-187	Forbestown Ditch near Clipper Mills		1927–41	USGS
5-188	Palermo Canal at Enterprise		1911–52	USGS
5-189	Feather River, South Fork, at Enterprise	134	1911–52	USGS
5-190	Feather River, Middle Fork, at Bidwell Bar	1,353	1911–52	USGS
5-191	Feather River near Oroville	3,611	1934–52	USGS
5-192	Feather River at Oroville	3,611	1902–34	USGS
5-194A	South Honcut Creek near Bangor	31	1950–52	USGS
5-194B	Honcut Creek at La Porte Road	69	1947–49	DWR
	Yuba River Basin			
5-195	Yuba River, North Fork, near Sierra City	91	1911–13, 1923–44	USGS
5-196	Yuba River, North Fork of North Fork, at Downieville	71	1910–26	USGS
5-197	Yuba River, North Fork, at Goodyear Bar	214	1910–31	USGS
5-198	Rock Creek at Goodyear Bar	9	1910–33	USGS
5-199	Goodyear Creek at Goodyear Bar	12	1910–33	USGS
5-200	Yuba River, North Fork, below Goodyear Bar	244	1930–37, 1938–52	USGS
5-201	Bullards Bar Reservoir, North Fork Yuba River		1936–39	PGE
5-202	Yuba River, North Fork, below Bullards Bar Dam		1940–41, 1950–52	USGS
5-203	Yuba River, North Fork, near North San Juan		1900	USGS
5-204	Yuba River, North Fork, at Colgate Diversion Dam	484	1940–50	USGS
5-205	Yuba River, Middle Fork, at Milton	41	1925–33, 1936–52	USGS
5-206	Yuba River, Middle Fork, above Oregon Creek	170	1941–52	USGS
5-207	Oregon Creek near North San Juan	35	1910–52	USGS
5-208	Yuba River, Middle Fork, near North San Juan	207	1910–41	USGS
5-209	Canyon Creek above Jackson Creek	19	1926–30	USGS
5-210	Jackson Creek at mouth	6	1926–30	USGS
5-211	Milton-Bowman Tunnel at outlet		1928–30, 1931–52	USGS
5-212	Bowman-Spaulding Canal at intake		1927–52	USGS
5-213	Canyon Creek below Bowman Lake	32	1927–52	USGS
5-214	Yuba River, South Fork, near Cisco	50	1942–52	USGS & USBR
5-215	Drum Canal near Lake Spaulding		1930–52	PGE
5-216	Spaulding Spillway at Lake Spaulding		1941–52	PGE
5-217	South Yuba Canal at Lake Spaulding		1930–52	PGE
5-218	South Yuba Canal at Deer Creek Power House		1930–52	PGE
5-219	Yuba River, South Fork, at Langs Crossing		1933–52	PGE
5-220	Yuba River, South Fork, near Washington	198	1942–52	USGS
5-221	Yuba River, South Fork, at Jones Bar Bridge	340	1940–48	USGS
5-222	Yuba River at Narrows Dam	1,110	1941–52	USGS
5-222A	Yuba River through Narrows Power House		1950–52	USGS
5-223	Cascade Ditch at head		1930–52	NID
5-224	Snow Mountain Ditch at head		1930–52	NID
5-225	D.S. Canal at head		1930–52	NID

TABLE 2—Continued

STREAM GAGING STATIONS IN OR ADJACENT TO MOTHER LODE REGION

Map reference number	Stream and location of gaging station	Drainage area, in square miles	Period of record	Source of record*
	Yuba River Basin—Continued			
5-226	Excelsior Ditch at head		1931-52	NID
5-227	Deer Creek near Smartville	84	1935-52	USGS
5-228	Yuba River at Smartville	1,201	1903-41	USGS
5-229	Yuba River at Parks Bar Bridge		1900	USGS
5-230	French Dry Creek near Brownsville	21	1946-52	USBR USGS
5-231	French Dry Creek at Virginia Ranch	72	1946-52	USBR USGS
5-232	Browns Valley Canal above Colgate Power House		1930-52	PGE
	Bear River Basin			
5-233A	Dry Creek near Waldo	69	1947-49	DWR
5-233B	Dry Creek near Wheatland		1946-52	USGS
5-235	Bear River near Colfax		1912-17 1949-52	USGS
5-236	Bear River near Auburn	140	1922, 25 28, 29, 33 1940-52	USGS
5-237	Bear River at Van Trent		1904-28	USGS
5-238	Bear River near Wheatland	295	1928-52	USGS
5-239	Boardman Canal near intake		1930-52	PGE
5-240	Lake Valley Canal near Emigrant Gap		1930-52	PGE
5-241	Drum Canal below Drum Forebay		1930-52	PGE
5-242	Bear River Canal near Colfax		1912-52	PGE
5-243	Gold Hill Canal below Combie Dam		1930-52	NID
	American River Basin			
5-263	Lake Valley Canal at intake		1930-37	PGE
5-264	American River, North Fork, near Colfax	308	1911-41	USGS
5-265	American River, North Fork, at North Fork Dam	343	1941-52	USGS
5-265A	American River, Middle Fork, at French Meadows		1951-52	USGS
5-266	Rubicon River at Rubicon Springs		1910-14	USGS
5-267	Little Rubicon River near Rubicon Springs		1911	USGS
5-268	Gerle Creek near Rubicon Springs		1910-14	USGS
5-269	Little South Fork Ditch at Sawmill		1910-13	USGS
5-270	Rubicon River, Little South Fork, at Sawmill		1910-14	USGS
5-271	Rubicon River, Little South Fork below Gerle Creek		1910-14	USGS
5-278	Rubicon River, Little South Fork, at mouth		1909-11	USGS
5-279	Rubicon River near Georgetown	198	1943-52	USGS
5-280	Pilot Creek near Quintette	15	1910-14 1946-52	USGS
5-281	Pilot Creek Ditch near Quintette		1910-14	USGS
5-281A	Georgetown Ditch above Pilot Creek		1950-52	USGS
5-281B	Georgetown Ditch near Georgetown		1947-52	USGS
5-282	American River, Middle Fork, near Auburn	619	1911-52	USGS
5-283	South Canal near Newcastle		1930-52	PGE
5-284	American River, North Fork, at Rattlesnake Bridge	999	1930-37 1938-52	USGS
5-285	Echo Lake Conduit near Vade		1923-52	PGE USGS
5-286	Medley Lakes Outlet near Vade	6	1922-52	PGE USGS
5-287	American River, South Fork, at Kyburz	196	1906-07 1923-24	USGS
5-288	Twin Lakes Outlet near Kirkwood	12	1922-52	USGS
5-289	Twin Lakes Spillway near Kirkwood		1925-52	USGS
5-290	Silver Lake near Kirkwood	15	1922-52	USGS
5-291	Seepage from Silver Lake near Silver Lake Dam		1929-45	USGS PGE
5-292	American River, Silver Fork of South Fork, near Kyburz	108	1924-41	USGS
5-293	American River, South Fork, below Silver Fork		1906	USGS
	American River Basin—Continued			
5-294	American River, South Fork, near Kyburz		1907 1922-52	USGS PGE
5-295	El Dorado Canal near Kyburz		1922-52	PGE USGS
5-296	Alder Creek near Whitehall	23	1922-52	USGS PGE
5-297	Plum Creek near Riverton	7	1922-39	USGS
5-298	Silver Creek at Union Valley	83	1924-52	USGS
5-299	Silver Creek, South Fork, near Ice House	28	1922 1924-52	USGS
5-300	Silver Creek near Placerville	176	1921-52	USGS
5-301	American River, South Fork, below Silver Creek		1923	USGS
5-302	American River Flume near Camino		1922-52	USGS PGE
5-303	American River, South Fork, near Camino	497	1922-52	PGE
5-304	Finnon Reservoir Outlet near Placerville		1922-37	USGS
5-305	American River, South Fork, near Placerville		1911-20	USGS
5-306	American River, South Fork, at Coloma	635	1929-41	USGS
5-306A	American River, South Fork, near Lotus	678	1951-52	USGS
5-307	Webber Creek near Salmon Falls	100	1943-52	USBR USGS
5-308	Lower Greeley Canal near Rattlesnake Bridge		1930-52	PGE
5-309	American River at Fair Oaks	1,921	1904-52	USGS
	San Joaquin River Basin			
5-635	Fresno River, North Fork, near Sugar Pine		1910-11	USGS
5-636	Nelder Creek near Fresno Flats		1910-12	USGS
5-637	Fresno River near Knowles	132	1911-13 1915-52	USGS
5-638	Fresno River near Daulton	270	1941-52	USGS
5-649	Chowchilla River at Buchanan Dam site	238	1921-23 1930-52	USGS
5-650	Chowchilla River at Foothills near Buchanan		1878-84	USGS
5-662	Deadman Creek at Merced Irrigation District east boundary		1941-42	USBR
5-663	Dutchman Creek at Merced Irrigation District boundary		1941-42	USBR
5-667	Mariposa Creek at Foothills		1878-84	USGS
5-668	Mariposa Creek near Merced Irrigation District east boundary	122	1942	USBR
5-668A	Mariposa Creek near La Grande		1936-43	MeID
5-670	Owens Creek at Merced Irrigation District east boundary		1940-42	USBR
5-671	Miles Creek at Merced Irrigation District east boundary		1942	USBR
5-674	Bear Creek at Merced Irrigation District east boundary		1942	USBR
5-674A	Bear Creek near Planada	164	1936-43	MeID
	Merced River Basin			
5-682	Merced River above Illilouette Creek		1915	USGS
5-683	Illilouette Creek near Yosemite		1915	USGS
5-684	Merced River at Happy Isles Bridge	181	1915-52	USGS
5-685	Tenaya Creek near Yosemite	47	1904-09 1912-52	USGS
5-686	Merced River at Yosemite	236	1912-16	USGS
5-687	Yosemite Creek at Yosemite	43	1904-09 1912-26	USGS
5-688	Merced River at Pohono Bridge	321	1916-52	USGS
5-689	Merced River, South Fork, near Wawona	131	1910-22	USGS
5-690	Big Creek near Wawona		1911	USGS
5-690A	Merced River, South Fork, near El Portal	239	1950-52	USGS

TABLE 2—Continued

STREAM GAGING STATIONS IN OR ADJACENT TO MOTHER LODE REGION

Map reference number	Stream and location of gaging station	Drainage area, in square miles	Period of record	Source of record*
	Merced River Basin—Continued			
5-690B	Merced River at Bagby	912	1947–52	USGS
5-691	Merced River at Kittredge (Horseshoe Bend)	935	1922–47	USGS
5-692	Merced River at Exchequer	1,035	1915–52	USGS
5-693	Merced River near Merced Falls		1901–13 1923–26	USGS
5-694	Merced River at Merced Falls		1895–12	USGS
5-695	Merced River below Snelling		1931–38 1939–52	DWRWS
	Tuolumne River Basin			
5-706	Falls Creek near Hetch Hetchy	45	1915–52	USGS
5-707	Tuolumne River at Hetch Hetchy Cabin		1910–16	USGS
5-708	Tuolumne River at Hetch Hetchy dam site		1910–15	USGS
5-709	Hetch Hetchy Reservoir at Hetch Hetchy	460	1923–52	USGS
5-710	Tuolumne River near Hetch Hetchy	462	1914–52	USGS
5-711	San Francisco Tunnel Diversion near Hetch Hetchy		1932–46	SFPUC
5-712	Eleanor Creek at Eleanor Trail crossing	81	1901	USGS
5-713	Eleanor Creek near Hetch Hetchy	80	1901 1901–52	USGS
5-714	Cherry Creek near Hetch Hetchy	111	1910–52	USGS
5-715	Cherry Creek at Eleanor Trail crossing		1901	USGS
5-716	Jawbone Creek near Tuolumne		1910–14	USGS
5-717	Corral Creek near Groveland		1910–13	USGS
5-718	Tuolumne River, Middle Fork, near Mather	51	1924–29	USGS
5-719	Tuolumne River, Middle Fork, at Oakland Recreation Camp	71	1916–52	USGS
5-720	Tuolumne River, South Fork, at Italian Flat		1924–33	USGS
5-721	Tuolumne River, South Fork, near Sequoia		1914–18	USGS
5-722	Golden Rock Ditch near Sequoia		1914–15	USGS
5-723	Tuolumne River, South Fork, near Oakland Recreation Camp	88	1923–52	USGS
5-724	Tuolumne River, South Fork, near Buck Meadows	71	1916–21	USGS
5-725	Tuolumne River near Buck Meadows		1907–09 1910–36	USGS
5-726	Indian Creek near Tuolumne		1911	USGS
5-727	Clavey Creek near Tuolumne		1910–13	USGS
5-728	Big Creek near Groveland	25	1931–33	USGS
5-729	Tuolumne River, North Fork, near Tuolumne		1911	USGS
5-730	Hunter Creek near Tuolumne		1910–12	USGS
5-731	Moccasin Power Plant Discharge near Hetch Hetchy		1936–52	SFPUC
5-732	Tuolumne River near Jacksonville	1,352	1923–34	USGS
5-734	Woods Creek near Jacksonville	98	1925–52	USGS
5-735	Sierra & San Francisco Power Co. Canal near La Grange		1908–26	USGS
5-736	Tuolumne River above La Grange Dam	1,540	1915–52	USGS
5-737	Modesto Canal near La Grange		1903–52	USGS
5-738	Turlock Canal near La Grange		1898–1952	USGS
5-739	Tuolumne River near La Grange	1,539	1895–1917	USGS
5-740	Tuolumne River at La Grange Bridge		1937–52	DWRWS TID
5-741	Tuolumne River at Roberts Ferry Bridge		1931–52	DWRWS MID
5-742	Tuolumne River at Hickman-Waterford Bridge		1932–52	DWRWS MID
	Stanislaus River Basin			
5-748	Lake Alpine Reservoir near Camp Tamarack		1929–52	PGE
5-749	Union Reservoir near Camp Tamarack		1929–52	PGE
5-750	Utica Reservoir near Camp Tamarack		1929–52	PGE
5-751	Spicers Reservoir Highland Creek		1929–52	PGE

Map reference number	Stream and location of gaging station	Drainage area, in square miles	Period of record	Source of record*
	Stanislaus River Basin—Continued			
5-752	Stanislaus River, North Fork, near Avery	163	1914–22 1928–52	USGS
5-753	Utica Gold Mining Co. Canal near Avery		1915–21	USGS
5-754	Relief Creek near Baker Station		1910–18	USGS
5-755	Stanislaus River, Middle Fork, at Kennedy Meadows	50	1938–52	USGS
5-755A	Stanislaus River, Clark Fork, near Dardanelles	66	1950–52	USGS
5-756	Stanislaus River, Middle Fork, at Sand Bar Flat	318	1905–52	USGS
5-757	Stanislaus Tunnel at outlet		1937–52	USGS
5-758	Knight Creek near Jupiter		1910–13	USGS
5-759	Rose Creek near Jupiter		1910–13	USGS
5-760	Stanislaus River, South Fork, at Strawberry	46	1911–17 1938–52	USGS
5-761	Philadelphia Canal near Strawberry		1939–52	USGS
5-762	Tuolumne Canal near Long Barn		1937–52	USGS
5-763	Stanislaus River, South Fork, near Long Barn	67	1937–52	USGS
5-764	Stanislaus River, South Fork, near Columbia		1910–12	USGS
5-765	Stanislaus River above Melones Power House	898	1932, 35, 38, 39 1941–52	USGS
5-766	Stanislaus River below Melones Power House	898	1931–52	USGS
5-767	Stanislaus River near Knights Ferry	972	1915–32	USGS
5-768	South San Joaquin Canal near Knights Ferry		1914–52	USGS
5-769	Oakdale Canal near Knights Ferry		1914–52	USGS
5-770	Stanislaus River at Knights Ferry		1903–14	USGS
5-771	Stanislaus River at Orange Blossom Bridge		1931–41 1941–52	DWRWS OID
5-784	Littlejohns Creek at Farmington		1926	USGS
	Calaveras River Basin			
5-784A	San Domingo Creek near San Andreas	27	1950–52	USGS
5-784B	San Antonio Creek near San Andreas	46	1950–52	USGS
5-784C	Calaveras River, South Fork, near San Andreas		1950–52	USGS
5-784 D	Calaveritas Creek near San Andreas		1950–52	USGS
5-784E	Murray Creek near San Andreas		1950–52	USGS
5-784F	Jesus Maria Creek near Mokelumne Hill	35	1550–52	USGS
5-784G	Esperanza Creek near Mokelumne Hill	17	1950–52	USGS
5-784 H	Calaveras River, North Fork, near San Andreas		1950–52	USGS
5-785	Cosgrove Creek near Valley Springs	21	1929–52	USGS
5-786	Calaveras River at Jenny Lind	395	1907–52	USGS
5-787	Calaveras River near Bellota		1878–84	USGS
5-790	Bear Creek near Clements		1927	USGS
5-791	Bear Creek near Lockeford	48	1933–52	USGS
	Mokelumne River Basin			
5-792	Upper Blue Lake near Carson Pass		1929–52	PGE
5-793	Lower Blue Lake near Carson Pass		1929–52	PGE
5-794	Twin Lakes near Carson Pass		1929–52	PGE
5-795	Meadow Lakes near Carson Pass		1929–52	PGE
5-796	Tiger Creek Power House Conduit below Salt Springs Dam		1931–52	USGS
5-797	Mokelumne River, North Fork, below Salt Springs Dam	160	1926–52	USGS
5-798	Cold Creek near Mokelumne Peak	23	1927–52	USGS
5-799	Bear River Reservoir near Pardoe Camp		1929–52	PGE
5-800	Bear River at Pardoe Camp	33	1927–52	USGS
5-801	Mokelumne River, North Fork, near West Point	272	1917–18 1924–32	USGS
5-802	Mokelumne River, North Fork, above Tiger Creek	360	1931–33 1936–52	USGS

TABLE 2—Continued

STREAM GAGING STATIONS IN OR ADJACENT TO MOTHER LODE REGION

Map reference number	Stream and location of gaging station	Drainage area, in square miles	Period of record	Source of record*
	Mokelumne River Basin—Continued			
5-803	Mokelumne River, North Fork, near Electra	--------	1933–35, 1939–47	USGS
5-804	Mokelumne River, Middle Fork, at West Point	67	1911–52	USGS
5-805	Mokelumne River, Licking Fork, near Railroad Flat	--------	1912, 1915–17	USGS
5-806	Mokelumne River, South Fork, near Railroad Flat	41	1911–34	USGS
5-807	Mokelumne River, South Fork, near West Point	74	1933–52	USGS
5-808	Upper Standard Canal, near West Point	--------	1929–48	PGE
5-809	Lower Standard Canal, near West Point	--------	1929–48	PGE
5-810	Mokelumne River at Electra	--------	1901, 1903–04	USGS
4-811	Mokelumne River near Mokelumne Hill	538	1927–52	USGS
5-812	East Bay Municipal Utility District Aqueduct near Valley Springs	--------	1929–33	USGS
5-813	Mokelumne River at Lancha Plana	584	1926–52	USGS
5-814	Camanche Creek near Camanche	5	1933–34	USGS
5-815	Rabbit Creek near Camanche	9	1932–34	USGS
5-816	Mokelumne River at Lone Star Mill	--------	1878–84	USGS
5-817	Murphy Creek near Clements	5	1932–34	USGS
	Mokelumne River Basin—Continued			
5-818	Mokelumne River near Clements	630	1904–52	USGS
5-824	Sutter Creek near Volcano	31	1924–27	USGS
5-825	Sutter Creek near Sutter Creek	51	1922–41	USGS
5-826	Amador Ditch near Electra	--------	1929–52	PGE
5-827	Dry Creek near Ione	279	1912, 1925–32	USGS
5-828	Goose Creek near Elliott	10	1927–33	USGS
5-829	Dry Creek near Galt	325	1926–52	USGS, EBMUD, USBR
5-830	Camp Creek near Sly Park	9	1924	USGS
5-830A	Camp Creek near Camino	36	1948–52	USGS
5-831	Sly Park Creek at Sly Park	--------	1906	USGS
5-831A	Sly Park Creek near Pollock Pines	14	1948–52	USGS
5-832	Camp Creek near Pleasant Valley	--------	1924	USGS
5-832A	Cosumnes River, North Fork, near Cosumnes Mine	37	1948–52	USGS
5-833	Cosumnes River, North Fork, near Pleasant Valley	--------	1924	USGS
5-834	Cosumnes River, North Fork, near El Dorado	--------	1911–41	USGS
5-835	Cosumnes River, Middle Fork, near Fair Play	--------	1913	USGS
5-835A	Cosumnes River near Plymouth	429	1951–52	USGS
5-836	Cosumnes River at Michigan Bar	537	1907–52	USGS
5-838	Hadselville Creek at Clay	--------	1930–31	USGS

* DWR Division of Water Resources.
DWRWA Division of Water Resources, Water Rights Adjudication.
DWRWS Division of Water Resources, Water Supervision.
EBMUD East Bay Municipal Utility District.
MeID Merced Irrigation District.
MID Modesto Irrigation District.
NID Nevada Irrigation District.
OID Oakdale Irrigation District.
PGE Pacific Gas and Electric Company.
SFPUC San Francisco Public Utilities Commission
TID Turlock Irrigation District.
USBR United States Bureau of Reclamation.
USGS United States Geological Survey.

APPENDIX C

COMPLETE MINERAL ANALYSES OF REPRESENTATIVE SURFACE WATERS OF THE MOTHER LODE REGION

COMPLETE MINERAL ANALYSES OF REPRESENTATIVE SURFACE WATERS OF THE MOTHER LODE REGION

Stream	Location of sampling station			Date of sample	Conductance, $Ec \times 10^6$ at 25°C.	Boron, in ppm	Mineral constituents, in equivalents per million							Sodium, in percent	Hardness factor
	Township	Range	Section				Ca	Mg	Na	$HCO_3 + CO_3$	Cl	SO_4	NO_3		
Chico Creek	24N	2E	36	10/ 2/52	165	0.12	0.80	0.70	0.38	1.70	0.08	0.06	trace	20	75
Big Butte Creek	22N	3E	8	10/ 1/52	109	0.07	0.60	0.34	0.25	1.11	0.05	0.04	0.00	21	47
West Branch Feather River	24N	4E	22	10/ 1/52	83	0.05	0.50	0.22	0.20	0.85	0.04	0.03	0.00	21	36
North Fork Feather River	25N	7E	20	10/ 3/52	114	0.03	0.55	0.40	0.25	1.11	0.07	0.05	0.01	20	48
North Fork Feather River	23N	5E	31	10/ 3/52	99	0.05	0.45	0.35	0.23	0.98	0.05	0.04	0.01	22	40
Middle Fork Feather River	20N	5E	32	10/ 2/52	128	0.08	0.75	0.28	0.34	1.15	0.10	0.12	0.00	24	52
Middle Fork Feather River	22N	12E	25	10/ 3/52	177	0.05	1.05	0.35	0.43	1.64	0.06	0.12	trace	23	70
South Fork Feather River	19N	5E	1	10/ 2/52	106	0.11	0.42	0.30	0.39	0.79	0.17	0.17	0.00	35	36
North Fork Yuba River	20N	10E	35	10/ 3/52	167	0.02	1.35	0.37	0.12	1.66	0.13	0.13	trace	7	86
North Fork Yuba River	19N	9E	18	10/ 3/52	138	0.04	1.00	0.31	0.15	1.31	0.09	0.10	0.00	10	66
North Fork Yuba River	18N	7E	24	10/ 3/52	121	0.03	0.80	0.27	0.18	1.16	0.06	0.10	0.00	14	54
Middle Fork Yuba River	18N	8E	28	10/ 3/52	146	0.00	0.90	0.36	0.27	1.25	0.09	0.21	trace	18	63
South Fork Yuba River	17N	12E	28	10/ 6/52	81	0.05	0.60	0.08	0.15	0.69	0.05	0.14	trace	18	34
South Fork Yuba River	17N	8E	33	10/ 3/52	96	0.06	0.55	0.18	0.24	0.70	0.09	0.19	0.00	24	37
Yuba River	16N	6E	29	10/ 2/52	108	0.04	0.70	0.28	0.16	0.93	0.08	0.12	0.00	13	49
Honcut Creek	18N	5E	35	1/27/53	104	0.00	0.41	0.34	0.30	0.88	0.10	0.09	0.01	28	38
Dry Creek	17N	6E	11	10/ 2/52	144	0.06	0.60	0.48	0.02	1.18	0.20	0.15	0.00	30	54
Bear River	13N	8E	5	10/ 6/52	107	0.03	0.55	0.21	0.23	0.61	0.34	0.06	0.00	23	38
Coon Creek	13N	6E	31	1/26/53	212	0.01	0.85	0.90	0.42	1.75	0.18	0.25	0.03	19	9
North Fork American River	12N	8E	1	10/ 6/52	107	0.03	0.65	0.26	0.15	0.95	0.07	0.13	trace	14	46
Rubicon River	13N	12E	7	9/30/52	53	0.04	0.28	0.05	0.17	0.38	0.14	0.02	0.00	33	17
Middle Fork American River	12N	8E	1	1/26/53	68	0.00	0.25	0.13	0.08	0.36	0.06	0.06	0.01	16	19
South Fork American River	11N	8E	35	9/30/52	48	0.03	0.22	0.10	0.22	0.38	0.14	0.03	trace	39	16
South Fork American River	11N	15E	29	9/29/52	26	0.06	0.14	0.01	0.15	0.23	0.07	0.02	0.00	47	8
North Fork Cosumnes River	9N	12E	7	9/29/52	59	0.06	0.28	0.12	0.22	0.51	0.08	0.04	0.01	33	20
Cosumnes River	8N	8E	36	1/27/53	84	0.00	0.34	0.30	0.16	0.66	0.09	0.10	0.01	20	32
Dry Creek	6N	9E	14	1/27/53	301	0.01	1.55	1.15	0.42	2.05	0.28	0.83	0.03	13	135
North Fork Mokelumne River	7N	13E	33	10/ 7/52	31	0.03	0.14	0.08	0.08	0.26	0.03	0.02	0.00	25	11
Middle Fork Mokelumne River	6N	13E	10	10/ 7/52	76	0.03	0.38	0.17	0.22	0.77	0.06	0.02	trace	27	28
South Fork Mokelumne River	4N	9E	2	10/ 7/52	87	0.03	0.55	0.17	0.18	0.82	0.10	0.05	trace	19	36
Mokelumne River	4N	11E	13	10/ 7/52	29	0.03	0.15	0.05	0.08	0.25	0.02	0.02	0.00	27	10
Mokelumne River	4N	8E	2	10/ 7/52	30	0.04	0.14	0.06	0.09	0.25	0.02	0.02	0.00	29	10
Calaveras River	4N	11E	13	10/ 7/52	269	0.04	1.60	0.81	0.42	2.36	0.25	0.25	0.00	15	120
Littlejohns Creek	1S	11E	13	10/ 7/52	131	0.10	0.60	0.46	0.28	1.73	0.08	0.04	0.00	21	53
North Fork Stanislaus River	5N	16E	16	10/ 7/52	37	0.00	0.21	0.09	0.09	0.36	0.02	0.03	trace	21	15
South Fork Stanislaus River	3N	15E	33	10/ 9/52	66	0.06	0.30	0.21	0.16	0.56	0.04	0.11	0.00	23	26
Stanislaus River	2N	14E	9	10/ 8/52	55	0.03	0.33	0.12	0.10	0.51	0.03	0.02	0.00	18	23
Dry Creek	2S	13E	29	1/27/53	193	0.02	0.65	0.80	0.48	1.43	0.23	0.25	0.04	24	72
North Fork Tuolumne River	2N	16E	34	10/10/52	14	0.01	0.07	0.02	0.05	0.13	0.01	0.01	0.00	33	5
Middle Fork Tuolumne River	1S	18E	28	10/10/52	68	0.05	0.35	0.13	0.19	0.69	0.03	0.02	0.00	32	24
South Fork Tuolumne River	1S	18E	29	10/10/52	66	0.02	0.37	0.12	0.14	0.61	0.04	0.02	0.00	22	25
Tuolumne River	1S	15E	20	10/10/52	68	0.02	0.36	0.12	0.19	0.66	0.03	0.01	0.00	27	24
Tuolumne River	3S	14E	20	10/ 8/52	24	0.04	0.12	0.05	0.06	0.21	0.02	0.02	0.00	27	9
Merced River	4S	15E	23	10/ 8/52	49	0.08	0.29	0.11	0.10	0.43	0.06	0.04	trace	20	20
South Fork Merced River	3S	19E	20	10/10/52	87	0.06	0.42	0.16	0.30	0.62	0.22	0.06	trace	33	29
Merced River	3S	20E	11	10/10/52	38	0.01	0.16	0.07	0.14	0.25	0.11	0.03	0.02	37	12

APPENDIX D

EXISTING RESERVOIRS AND HYDROELECTRIC POWER PLANTS IN AND ADJACENT TO THE MOTHER LODE REGION

TABLE OF CONTENTS

EXISTING RESERVOIRS AND HYDROELECTRIC POWER PLANTS IN AND ADJACENT TO THE MOTHER LODE REGION

TABLE 1

EXISTING RESERVOIRS IN AND ADJACENT TO THE MOTHER LODE REGION

Name	Owner	Stream	Storage capacity, in acre-feet
Bowman Lake	Nevada Irrigation District	Canyon Creek	68,000
Bucks Lake	Pacific Gas and Electric Company	Bucks Creek	103,000
Bullards Bar	Pacific Gas and Electric Company	North Fork Yuba River	31,489
Butt Valley	Pacific Gas and Electric Company	Butt Creek	49,768
Camp Far West	Camp Far West Irrigation District	Bear River	5,000
Cherry Valley	City and County of San Francisco	Cherry Creek	268,000
Concow	Thermalito and Table Mountain Irrigation Districts	Concow Creek	8,600
Dallas-Warner	Modesto Irrigation District	Tributary to Tuolumne River	27,000
Don Pedro	Modesto and Turlock Irrigation Districts	Tuolumne River	289,000
Echo Lake	Pacific Gas and Electric Company	Tributary to Upper Truckee River	1,900
Englebright	California Debris Commission	Yuba River	70,000
Exchequer	Merced Irrigation District	Merced River	289,000
Farmington	United States Corps of Engineers	Littlejohns Creek	52,000
Folsom	United States Bureau of Reclamation	American River	1,000,000
French Lake	Nevada Irrigation District	Canyon Creek	12,500
Hetch Hetchy	City and County of San Francisco	Tuolumne River	360,000
Hogan	City of Stockton	Calaveras River	76,000
Kunkle	Pacific Gas and Electric Company	Kunkle Creek	253
Lake Almanor	Pacific Gas and Electric Company	North Fork Feather River	1,308,000
Lake Combie	Nevada Irrigation District	Bear River	9,000
Lake Eleanor	City and County of San Francisco	Eleanor Creek	27,800
Lake Fordyce	Pacific Gas and Electric Company	Fordyce Creek	46,662
Lake Spaulding	Pacific Gas and Electric Company	South Fork Yuba River	74,488
Lake Tabeaud	Pacific Gas and Electric Company	Jackson Creek	1,165
Lake Valley	Pacific Gas and Electric Company	North Fork of North Fork American River	8,127
Lake Wyandotte	Oroville-Wyandotte Irrigation District	North Honcut Creek	1,300
Loon Lake	Georgetown Divide Public Utility District	Gerle Creek	8,000
Lost Creek	Oroville-Wyandotte Irrigation District	Lost Creek	5,200
Lower Bear River	Pacific Gas and Electric Company	Bear River	48,500
Lower Blue Lake	Pacific Gas and Electric Company	Blue Creek	4,300
Lyons	Pacific Gas and Electric Company	South Fork Stanislaus River	5,508
Magalia	Paradise Irrigation District	Little Butte Creek	3,540
Main Strawberry	Pacific Gas and Electric Company	South Fork Stanislaus River	18,600
Meadow Lake	Pacific Gas and Electric Company	Tributary to North Fork Mokelumne River	5,850
Melones	Oakdale and South San Joaquin Irrigation Districts	Stanislaus River	112,500
Mountain Meadows	Pacific Gas and Electric Company	Hamdton Creek	24,800
North Fork	California Debris Commission	North Fork American River	14,600
Owens	Turlock Irrigation District	Tributary to Tuolumne River	49,000
Pardee	East Bay Municipal Utility District	Mokelumne River	210,000
Philbrook	Pacific Gas and Electric Company	Phdbrook Creek	4,875
Phoenix	Pacific Gas and Electric Company	Sullivan Creek	850
Relief	Pacific Gas and Electric Company	Relief Creek	15,122
Round Valley	Pacific Gas and Electric Company	North Fork Feather River	1,285
Salt Springs	Pacific Gas and Electric Company	North Fork Mokelumne River	139,400
Salt Spring Valley	Rock Creek Water District	Rock Creek	10,900
Schaad	Calaveras Public Utility District	Middle Fork Mokelumne River	1,718
Scotts Flat	Nevada Irrigation District	Deer Creek	26,300
Silver Lake	Pacific Gas and Electric Company	Silver Fork of American River	8,726
Silver Valley	Pacific Gas and Electric Company	Tributary to North Fork Stanislaus River	4,600
Sly Park	United States Bureau of Reclamation	Sly Park Creek	41,000
Spicer Meadows	Pacific Gas and Electric Company	Highland Creek	3,800
Twin Lakes	Pacific Gas and Electric Company	Tributary to North Fork Mokelumne River	1,300
Twin Lake	Pacific Gas and Electric Company	Cables Creek	21,250
Upper Bear River	Pacific Gas and Electric Company	Bear River	6,712
Upper Blue Lake	Pacific Gas and Electric Company	Blue Creek	7,500
Union	Pacific Gas and Electric Company	North Fork Stanislaus River	2,000
Utica	Pacific Gas and Electric Company	North Fork Stanislaus River	2,400
Webber Creek	El Dorado Irrigation District	Webber Creek	1,275
Woodward	South San Joaquin Irrigation District	Simmons Creek	35,000
Yosemite Lake	Merced Irrigation District	Tributary to San Joaquin River	7,000

TABLE 2

EXISTING HYDROELECTRIC POWER PLANTS IN AND ADJACENT TO THE MOTHER LODE REGION

Name	Owner	Stream	Installed power capacity, in kilowatts[a]
Alta	Pacific Gas and Electric Company	Bear River	1,800
American River	Pacific Gas and Electric Company	South Fork American River	5,600
Angels	Pacific Gas and Electric Company	Angels Creek	1,000
Bear River Unit (Salt Springs Power House)	Pacific Gas and Electric Company	North Fork Mokelumne River	29,000
Big Bend	Pacific Gas and Electric Company	North Fork Feather River	70,000
Bucks Creek	Pacific Gas and Electric Company	North Fork Feather River	60,000
Bullards Bar	Pacific Gas and Electric Company	North Yuba River	7,500
Caribou	Pacific Gas and Electric Company	North Fork Feather River	73,000
Centerville	Pacific Gas and Electric Company	Big Butte Creek	6,400
Coal Canyon	Pacific Gas and Electric Company	West Fork Feather River	900
Colgate	Pacific Gas and Electric Company	Yuba River	25,000
Cresta	Pacific Gas and Electric Company	North Fork Feather River	70,000
Deer Creek	Pacific Gas and Electric Company	Deer Creek	5,700
De Sabla	Pacific Gas and Electric Company	Big Butte Creek	13,000
Don Pedro	Turlock and Modesto Irrigation Districts	Tuolumne River	26,990
Drum	Pacific Gas and Electric Company	Bear River	52,000
Dutch Flat	Pacific Gas and Electric Company	Bear River	22,000
Early Intake	City and County of San Francisco	Tuolumne River	3,600
El Dorado	Pacific Gas and Electric Company	South Fork American River	21,000
Electra	Pacific Gas and Electric Company	Mokelumne River	92,000
Exchequer	Merced Irrigation District	Merced River	25,000
Folsom No. 2[b]	United States Bureau of Reclamation	American River	162,000
Halsey	Pacific Gas and Electric Company	Dry Canyon	11,000
Hamilton Branch	Pacific Gas and Electric Company	Hamilton Branch, North Fork Feather River	4,800
La Grange	Turlock and Modesto Irrigation Districts	Tuolumne River	3,900
Lime Saddle	Pacific Gas and Electric Company	West Branch, Feather River	2,000
Melones	Pacific Gas and Electric Company	Stanislaus River	26,000
Merced Falls	Pacific Gas and Electric Company	Merced River	3,500
Moccasin	City and County of San Francisco	Moccasin Creek	70,000
Murphys	Pacific Gas and Electric Company	Angels Creek	3,800
Narrows	Pacific Gas and Electric Company	Yuba River	12,000
Nimbus[c]	United States Bureau of Reclamation	American River	13,500
Pardee	East Bay Municipal Utility District	Mokelumne River	15,000
Phoenix	Pacific Gas and Electric Company	Sullivan Creek	1,800
Rock Creek	Pacific Gas and Electric Company	North Fork Feather River	110,000
Salt Springs	Pacific Gas and Electric Company	North Fork Mokelumne River	12,000
Spaulding No. 1	Pacific Gas and Electric Company	South Yuba River	7,000
Spaulding No. 2	Pacific Gas and Electric Company	South Yuba River	4,400
Spaulding No. 3	Pacific Gas and Electric Company	South Yuba River	5,800
Spring Gap	Pacific Gas and Electric Company	Middle Fork Stanislaus River	7,000
Stanislaus	Pacific Gas and Electric Company	Stanislaus River	40,000
Tiger Creek	Pacific Gas and Electric Company	North Fork Mokelumne River	58,000
Wise	Pacific Gas and Electric Company	Auburn Ravine	14,000
West Point	Pacific Gas and Electric Company	North Fork Mokelumne River	15,000
Yosemite	U. S. Department of the Interior, National Park Service	Merced River	2,000

[a] Pacific Gas and Electric Company power plant capacities are "gross normal operating capacities" as defined by the company.
[b] Generating units to be installed in 1954 and 1955.
[c] Generating units to be installed in 1955.

APPENDIX E

REPORT OF BOARD OF REVIEW ON THE LAND CLASSIFICATION SURVEY OF CALAVERAS AND TUOLUMNE COUNTIES

REPORT BY BOARD OF REVIEW, ON THE LAND CLASSIFICATION SURVEY OF CALAVERAS AND TUOLUMNE COUNTIES CALIFORNIA

October, 1950

At the request of A. D. Edmonston, State Engineer, Walter W. Weir, Division of Soils, University of California; Robert A. Gardner, Division of Soil Survey, U. S. Department of Agriculture; and Ralph C. Cole, Branch of Operation and Maintenance, U. S. Bureau of Reclamation, were designated by their respective organizations to constitute a Board for the review of a classification of the lands of Calaveras and Tuolumne Counties as to their suitability for irrigation. The field examination was made on September 18, 19, and 20, 1950, followed by an office conference on September 21, 1950. During these investigations the Board was accompanied by John W. Shannon and Roy N. Haley of the Division of Water Resources, who had conducted the field work and made the classification which was being reviewed. The findings of this Board are set forth in the following paragraphs.

DISCUSSION OF STANDARDS

The land classification standards as given in the typewritten report, "Land Classification Standards and Criteria, Survey of Mountainous Areas, Calaveras and Tuolumne Counties," by Mr. Shannon were carefully reviewed prior to the inspection of the mapping. In these investigations the paramount considerations were: first, whether or not the standards were adequate to cover all land which could be considered suitable for irrigation in these counties, and second, whether or not the lands were mapped in compliance with the classification standards set up.

During the course of the field inspection it was observed:

(1) In the field mapping both loose rock and rock outcroppings were considered, whereas the specifications in Table 1 of "Land Classification Standards and Criteria, Survey of Mountainous Areas, Calaveras and Tuolumne Counties", mention loose rock only. It is agreed that both of these items should be considered in the classification.

(2) In mapping Class 4(3) lands wherever depth of soil is the limiting factor, stoniness sufficient to slightly reduce productivity and interfere with cultural practices is permitted as inclusions within the land class, whereas when the soils are deep and slope is the important factor in the delineation, stoniness to moderately reduce productivity and interfere with cultural practices is permitted as an inclusion. In the specifications (Table 1) a moderate amount of stoniness is permitted in all of Class 4(3) lands. It is agreed that less stoniness should be permitted where the soils are shallow.

(3) Class 4-P as mapped permits of slopes up to the maximum of Class 4(3) and stoniness only to the maximum of Class 4(2). The major criteria in this class is the extreme shallowness of the soil. The specifications are indefinite in this respect and should be more specifically defined.

In order to more carefully check the minimum standards for Class 4(3) and 4-P the Storie Index for the minimum requirements for each was computed and was found to range between 17 and 20 per cent. It was concluded that this value represents the extreme lower limits of lands that can be considered suitable for irrigation.

All other land classes mapped within the area are considered properly defined. The board also considers that all land classes suitable for irrigation are included within the land classes used in this survey.

CONSIDERATION OF MAPPING

The field mapping was done on contact prints of aerial photographs of scale 1 to 20,000. Land classification areas were delineated in the field according to field observations of topography, depth of soil, and stoniness and rockiness. These field observations were later checked in the field office by stereoptic observations particularly for slope, stoniness and rockiness. The mapping was done on a reconnaissance basis, each mapper covering about 6 to 8 square miles per day.

It was observed that there were instances where small tracts of lands suitable for irrigation but isolated by extensive areas of land not suitable for irrigation were not mapped out. Likewise there were small bodies of land not suitable for irrigation that were included in large areas of lands suitable for irrigation. This is what would be expected on this type of survey. More precise separations could only be accomplished by mapping in greater detail. It is believed, however, that greater detail in mapping would not materially alter the acreage of land suitable for irrigation for each county from that found by this survey.

The field inspections revealed that the mapping was done consistent with the specifications established with the exceptions noted above, and that these exceptions more properly define these classes than do the specifications presented in the report.

In considering the classification and mapping in these two counties special attention was paid to the following areas for each of which a brief discussion is given of the soil conditions and mapping problems encountered.

1. Keystone Area

In the Keystone area the soils are in the main relatively shallow and rocky with considerable complexity of relief patterns. These soils are in the main of the Dorado and Auburn soil series. The Dorado soils are relatively shallow having been formed on metamorphosed sedimentary rock materials. The soils of the Auburn series are formed on metamorphosed igneous rocks, particularly amphybolite schist. The very limited acreage now irrigated in this area is devoted to irrigated pasture, with yields being fair to poor.

2. Jamestown and Chinese Camp Area

Here the soils are also mainly of the Dorado and Auburn soil series, and the conditions are similar to those described for the Keystone area. There is probably a slight increase in the acreage under irrigation in this area.

3. Groveland Area

In the Groveland area the soils are of good depth, usually four feet or more to bedrock. They are largely from basic igneous rocks and may be classified as members of the Aiken series. The mapping problems in this area consisted largely in mapping out areas of favorable topography. Most of the exclusions consist of areas with very complex relief patterns or with slopes that are so steep that they were not considered favorable for irrigation. There is only a very small amount of irrigation in the Groveland area.

4. Standard, Tuolumne Area

The soils here are derived mainly from granitic rock sources, and they consist mostly of soils of the Sierra, Cuyamaca, and Holland series. The Sierra soils are red; the Cuyamaca soils have pale surface soils with redder subsoils, and the Holland soils are brown or greyish-brown. In general, the soils are deep, and the mapping problems consist largely of mapping suitable topography for irrigation. In this locality the slopes are complex and there are some very steep slopes. The irrigated crops in this area consist largely of apples. There is also a little irrigated pasture. Production appears to be only fair in this locality.

5. Sonora, Columbia, and Murphy Areas

In this area there are considerable outcroppings of limestone. The soils are rather shallow and are derived from the limestone. Also in this locality are rather shallow rocky soils, red in color, derived from basic igneous rocks probably closely associated with soils of the Auburn series. In this area there are some alluvial soils on the stream bottoms. Most of the mapping problems in the Sonora, Columbia, and Murphys areas are involved in rough complex slopes and shallow and stony soils. There are some apples and irrigated pasture in this area, most of the apples being in the vicinity of Murphys and largely on stream bottom lands rather than on the upland soils.

6. Sheep Ranch, Angels Camp Area

In this area the soils are derived largely from metamorphosed sedimentary rocks, but the soils are deeper than those listed for the Keystone and Chinese Camp areas. These soils consist largely of those comprising the Sites series, but there are also some soils of the Aiken series. These lie at higher elevations around Averys.

In this particular district we made special observations at Ariola Ranch, west of Frogtown, where gravity irrigation is in use on relatively steep slopes for irrigated pasture. The soils are members of the Sites series, and the area was classified as 4(3). This particular pasture looked good.

7. Mountain Ranch and Railroad Flat Areas

The soils in this area are mainly of the Sites series having medium depth and complex slopes. There are also some alluvial soils along the stream bottoms. Irrigated pasture, walnuts, and apples are grown in this area. Although some of the trees appear to be very productive there is a great difference in sizes of trees throughout the orchards, giving these orchards a spotty appearance. The one exception was the Mountain Ranch orchard where the trees appeared to be making good growth and were relatively uniform in size. This orchard is on alluvial soils, Class 2. There are rather extensive clearings of land now in progress in the vicinity of Mountain Ranch.

8. West Point Area

This area consists largely of soils derived from granitic rocks. The soils are largely of the Sierra and Cuyamaca series. In this area the soils are deep. Mapping problems consisted largely of separating lands of suitable topography. In many areas the slopes are very complex. The crops in this area are mainly walnuts, some of which are irrigated and some are grown without irrigation. Although the trees on the irrigated areas look better than those which are not irrigated there is considerable spottiness in all the orchards. The total area in crops is small.

9. *Mokelumne Hill, San Andreas*

This area consists largely of shallow soils formed on slates largely of the Mariposa series. Irrigated areas consist mainly of irrigated pasture with a small amount of fruit in the vicinity of Mokelumne Hill. Although the slopes in this area are not overly steep the topography is very irregular. There is a great amount of rockiness and stoniness with a considerable amount of slate outcroppings.

10. *Salt Springs Valley*

Salt Springs Valley contains considerable alluvial stream bottom land which is classified mainly as Class 2. These areas are suitable for irrigation for fruit, pasture, and other forage crops. The upland soils in the Salt Springs area are very shallow, although the slopes are not excessive. The principal soils series are the Amador, White Rock and related series. The Amador soils are formed on rocks consisting largely of rhyolite tuffs. These soils have favorable macro-relief, but are cut up with hog-wallow micro-relief. They are also very shallow and because of the acidic nature of the parent rocks they have a low nutrient level, and are not very productive. Soils of the White Rock series are formed from light colored slates. These soils are extremely shallow and are likewise relatively infertile. Areas of both Amador and White Rock series are mapped as Class 4(P) suitable only for irrigated pasture.

11. *Milton-Valley Springs Area*

In this area there are also considerable acreages of alluvial soils similar to the Salt Springs Valley area and also extensive areas of soils of the Amador series which have the same adaptability as those described in the Salt Springs area. In addition to these soils there are some soils of the Whitney, Auburn, and Pentz series. Attention was called to several areas in which old and fairly good olive orchards occur. For the most part these olive orchards are on soils of the Whitney and Auburn series. Both of these soils are much better adapted to these crops than are the Amador and Pentz soils. The Amador and Pentz soils are much more extensive in area. As a matter of fact most of the Whitney and Auburn soils of this area which have topography suitable for irrigation are planted to olives. In general, the Pentz soils have rough topography. They are represented by the "haystack mountain" type of topography which is so conspicuous in this area. The Amador soils occupy lower lying positions. The Whitney soils are formed on brown sandstones and conglomerates and are of medium depth. Also in this area are some old valley terraces consisting mostly of soils of the Redding series. These soils have gravelly and cobbly surface textures and have hardpans at relatively shallow depths. Although suited for irrigated pasture, they are not suitable for fruit.

In summary it is felt that the specifications used for this survey are adequate to cover all lands which can be considered suitable for irrigation It is felt that the mapping has been consistent with the mapping standards established. In the lower portions of both Calaveras and Tuolumne Counties most of the 4(P) lands have relatively favorable topography. The slopes usually are less than 20 per cent with the majority of areas averaging not over 15 per cent in slope. Because of the infertility of some of the soils of this area, particularly those derived from the Amador and White Rock series, it is felt that some of the mapping is probably a little too generous, and some of these areas mapped as 4(P) might better have been mapped as Class 6.

At the higher elevations throughout the two counties the main consideration was relief involving mainly complexity of slopes, and here the classification and mapping are entirely adequate and satisfactory. Throughout the entire review of the field mapping we did not encounter any area of significant size where it was felt the mapping was too severe or where lands should be raised to a higher class.

(Signed) Walter W. Weir
University of California

(Signed) Robert A. Gardner
U. S. Department of Agriculture

(Signed) Ralph C. Cole
U. S. Bureau of Reclamation

APPENDIX F

APPLICATION OF WATER IN EDEN VALLEY, PENRYN VALLEY, SAILOR RAVINE, AND FROM SHIRLAND DITCH, PLACER COUNTY, 1951

TABLE OF CONTENTS

APPLICATION OF WATER IN EDEN VALLEY, PENRYN VALLEY, SAILOR RAVINE, AND FROM SHIRLAND DITCH, PLACER COUNTY, 1951

APPLICATION OF WATER ON PORTION OF EDEN VALLEY WATERSHED, PLACER COUNTY, 1951

Location: T. 14 N., R. 9 E., M. D. B. & M., portions of Sections 16 and 21
Average elevation .... 2,350 feet

Drainage area .... 384 acres
Irrigated lands .... 113 acres
Tules and brush .... 11 acres

(In acre-feet)

Period	Regulated inflow to irrigated lands	Rainfall on watershed	Total inflow	Outflow	Water retained in watershed	Regulated water retained in watershed
5-1 to 5-31	58	114	172	65	107	18*
6-1 to 6-30	56	------	56	21	35	35
7-1 to 7-31	58	------	58	15	43	43
8-1 to 8-31	58	------	58	11	47	47
9-1 to 9-30	56	------	56	9	47	47
5-1 to 9-30	286	114	400	121	279	190
Less applied water consumed by tules and brush (estimated)						44
Applied water retained by irrigated lands						146
Average retention of applied water by irrigated lands 1.3 feet 15.5 inches						

* Estimated from daily records of inflow, outflow, and precipitation.

NOTES: The inflow stations for this study consisted of 15 diversions from the Boardman Canal regularly measured by the Pacific Gas and Electric Company. The outflow station consisted of a water stage recorder on a drain, installed, rated, and operated during the study by the Division of Water Resources.

The orchards in this watershed vary in size of trees from large to small. The side slopes are on about 8 per cent grade. Hillside native vegetation is pine forest and manzanita brush.

APPLICATION OF WATER ON PENRYN VALLEY, PLACER COUNTY, 1951

Location: T. 11 N., R. 7 E., M. D. B. & M., portions of Sections 3, 4, 5, 8, 9, and 17; T. 12 N., R. 7 E., M. D. B. & M., portions of Sections 26, 27, 28, 32, 33, and 34
Average elevation .... 500 feet

Drainage area .... 6,025 acres
Irrigated lands .... 3,240 acres
Tules and brush .... 1,020 acres

(In acre-feet)

Period	Regulated inflow to irrigated lands	Rainfall on watershed	Total inflow	Outflow	Water retained in watershed	Regulated water retained in watershed
5-1 to 5-31	1,786	748	2,534	505	2,029	1,236*
6-1 to 6-30	2,325	------	2,325	95	2,230	2,230
7-1 to 7-31	2,631	------	2,631	95	2,536	2,536
8-1 to 8-31	2,719	------	2,719	111	2,608	2,608
9-1 to 9-30	2,311	------	2,311	250	2,061	2,061
5-1 to 9-30	11,772	748	12,520	1,056	11,464	10,671
Less applied water consumed by tules and brush (estimated)						4,080
Applied water retained by irrigated lands						6,591
Average retention of applied water by irrigated lands 2.0 feet 24.4 inches						

* Estimated from daily records of inflow, outflow, and precipitation.

NOTES: Inflow stations for this study were at the head of the Antelope Canal and on the Red Ravine Canal at the Southern Pacific Railway crossing. The outflow stations were on Antelope Creek near Rocklin, and wastes from the Antelope Canal at Clover Valley Reservoir and at the end of the canal. All stations were installed, rated, and operated by the Division of Water Resources.

The lower three-fourths of Penryn Valley has a slope of about 1 per cent and the upper fourth has a slope of about 4 per cent. Orchards vary from very good to poor. Hillside native vegetation is oak and brush.

APPLICATION OF WATER ON SAILOR RAVINE WATERSHED, PLACER COUNTY, 1951

Location: T. 13 N., R. 7 E., M. D. B. & M., portions of Section 36; T. 13 N., R. 8 E., M. D. B. & M., portions of Section 31
Average elevation .... 1,500 feet

Drainage area .... 360 acres
Irrigated lands .... 209 acres
Tules and brush .... 16 acres

(In acre-feet)

Period	Regulated inflow to irrigated lands	Rainfall on watershed	Total inflow	Outflow	Water retained in watershed	Regulated water retained in watershed
5-1 to 5-31	96	98	194	71	123	36*
6-1 to 6-30	158	------	158	48	110	110
7-1 to 7-31	164	------	164	50	114	114
8-1 to 8-31	164	------	164	51	113	113
9-1 to 9-30	158	------	158	61	97	97
5-1 to 9-30	740	98	838	281	557	470
Less applied water consumed by tules and brush (estimated)						64
Applied water retained by irrigated lands						406
Average retention of applied water by irrigated lands 2.0 feet 23.4 inches						

* Estimated from daily records of inflow, outflow, and precipitation.
NOTES: The inflow stations for this study consisted of 3 Nevada Irrigation District diversion boxes on the Vernon Extension Canal and Roehr Pipe Line, regularly measured by the District. The outflow station consisted of a water stage recorder on Sailor Ravine below the Francis Ranch, installed, rated, and operated by the Division of Water Resources.
This watershed is characterized by excellent orchards, mostly cover-cropped, and averaging about 6 per cent slopes. Hillside native vegetation is mostly oak.

APPLICATION OF WATER ON SHIRLAND DITCH WATERSHED, PLACER COUNTY, 1951

Location: T. 12 N., R. 8 E., M. D. B. & M., portions of Sections 27, 28, 33, and 34
Average elevation .... 1,050 feet

Drainage area .... 1,325 acres
Irrigated lands .... 687 acres
Tules and brush .... 121 acres

(In acre-feet)

Period	Regulated inflow to irrigated lands	Rainfall on watershed	Total inflow	Outflow	Water retained in watershed	Regulated water retained in watershed
5-1 to 5-31	228	361	589	128	461	104*
6-1 to 6-30	465	------	465	81	384	384
7-1 to 7-31	482	------	482	56	426	426
8-1 to 8-31	434	------	434	59	375	375
9-1 to 9-30	415	------	415	105	310	310
5-1 to 9-30	2,024	361	2,385	429	1,956	1,599
Less applied water consumed by tules and brush (estimated)						484
Applied water retained by irrigated lands						1,115
Average retention of applied water by irrigated lands 1.6 feet 19.5 inches						

* Estimated from daily records of inflow, outflow, and precipitation.
NOTES: The inflow station for this study was located on the Shirland Ditch at its head. The outflow stations were located on Mormon Creek above the South Canal and on the Shirland Drain near Scott's Corner. The stations were installed, rated, and operated by the Division of Water Resources.
The lands irrigated in this watershed are on 8 per cent or steeper slopes. Hillside native vegetation is mostly oak and brush with scattered pine.

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